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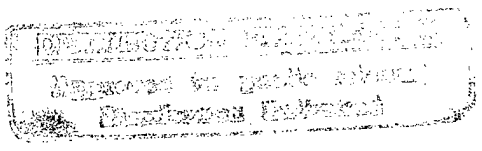
Central Eurasia: Electronics & Electrical Engineering



Science & Technology

Central Eurasia: Electronics & Electrical Engineering

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What a Journal Does to Remain Viable and Grow Under New Conditions

937K0147A Moscow SVETOTEKHNIKA in Russian No 1, Jan 93 pp 1-5

[Article by Yu.B. Ayzenberg, chief editor]

[Abstract] Transition to a market economy makes the publication of SVETOTEKHNIKA, just as that of other technical journals, pass through a period of hardship inevitably caused by such a radical changing of the economic structure. With governmental subsidy no longer available, inasmuch as the USSR Ministry of Electrical Equipment and Instrument Manufacturing Industry has been abolished, financial viability of the SVETOTEKHNIKA journal must be ensured by other means. This is a difficult task under present conditions of political disintegration and economic upheaval, absence of adequate regulation giving rise to price instability and general uncertainty. Aided by promptly forthcoming support from several lighting equipment enterprises, management of SVETOTEKHNIKA was nevertheless able not only to meet its financial obligations for the year 1991 but also to publish its regular first six 1992 issues. In the second half of 1992, however, it was forced to publish only four issues by combining Nos 7-8 into one and Nos 10-11 into one. In an effort to convert publication of SVETOTEKHNIKA into a commercially sound enterprise, the editorial staff does market research and uses advertising through the media aimed at interested individual specialists throughout the former USSR. Selling subscriptions at a price which will cover not only publication costs but also mailing and handling costs should prove to be very effective, especially since SVETOTEKHNIKA is now the sole provider of comprehensive scientific and technical information on lighting. Soliciting reluctant lighting equipment makers and users for financial support has not been very successful, though some of it must be gratefully acknowledged. So far only the Consumers' Societies Union "Lisma" (V.A. Levakin, general manager), the Scientific-Industrial Association "Vatra" (R.Yu. Yaremchuk, general manager), and management of the Leninsk-Kuznetsk electric lamp manufacturing plant (N.V. Geraskin, director) have offered financial sponsorship: 50,000 rubles, 45,000 rubles, and 72,000 rubles respectively, to cover the cost of advertising. Several technical innovations will enhance the quality of this journal, a changeover from intaglio printing to offset printing having already been effected and a changeover from black-and-white to color edition being under serious consideration. A very important other innovation will be simultaneous issuance of both original Russian-language and translated English-language versions, with inclusion of increasingly more articles by foreign authors. Negotiations are underway between the editorial staff and board members (who include illumination engineers from not only Russia but also other countries of the former USSR: Byelarus, Ukraine, Estonia, Latvia, Lithuania, Armenia, Georgia) and representatives from several foreign countries (Poland, Bulgaria, Germany, United States, Great Britain, Australia, Japan, India) regarding publication of articles by Russian authors in their journals as well as of articles by their authors in SVETOTEKHNIKA. Under the terms of agreement with the joint Russian-American consortium "Interperiodica", moreover, Allerton Press will in 1993 begin publishing the journal LIGHT & ENGINEERING as the English-language version of SVETOTEKHNIKA in four quarterly issues containing 50 pages each. As a way to enhance the quality of the translation and to reduce the cost of its publication so as to make it more profitable, the editorial staff of SVETOTEKHNIKA has proposed that the translation be done in Moscow by illumination engineering experts with adequate linguistic expertise and with the aid of complete word processing equipment (personal computers, laser printer, xerox machine, facsimile apparatus). All these innovations will require a speedy reorganization of the SVETOTEKHNIKA staff, including formation of independent legal and accounting departments familiar with banking procedures. As far as the content of this journal is concerned, a key goal will be to maintain its high scientific and technical level along with its practical usefulness.

UGRA-4000

937K0145A Moscow RADIO in Russian No 3, Mar 93 pp 2-4

[Article by A. Miloslavskiy and M. Shestov, Moscow]

[Abstract] The relatively new firm of ARTVIS has developed its first product, the UGRA-4000 ultrashortwave FM transmitter, which meets international standards and is comparable to foreign products in specifications and performance. This is the first domestic transmitter available for either the 65.9-74.0 or the 87.5-108 MHz range. Development was promoted by radio broadcasting specialists in the Russian Federation Ministry of Communications. Rated output of the transmitter, built with semiconductor components, is 5,000 watts. Configurations include from one to four main transmitters and one backup. Figures 2.

Import Telephone in Your Home

937K0145B Moscow RADIO in Russian No 3, Mar 93 pp 10-11

[Article by A. Grishin, Moscow]

[Abstract] Interest in imported telephone sets has dropped sharply due to numerous problems consumers have experienced in using them. In addition, the Ministry of Communications has threatened consumers using imported sets with fines for causing overloads on the domestic telephone network. The problems are due to the differences between domestic and foreign automatic telephone exchanges. In Russia, all exchanges use the pulse system. The supply voltage for Russian exchanges is 60V DC while that of foreign exchanges is 40V. Although some imports have been adapted for the Russian conditions, checks showed even those sets had inadequate resistors. Domestic electromechanical sets operate reliably with the different generations of exchanges in use in the country, some produced in the period from the thirties to the fifties, and some modern quasi-electronic and electronic. The import sets do not work well with the older exchanges.

Foreign Picture Tubes in Domestic Color Television Sets

937K0145C Moscow RADIO in Russian No 3, Mar 93 pp 21-24

[Article by G. Fligelman, Moscow]

[Abstract] There are now a large number of domestic color television sets which have foreign pictures tubes installed. The standard system for designation of picture tubes, developed by the Electronics Industry Association in the U.S. and in use worldwide since 1986, is explained. Details are given for foreign tubes ranging in size from 42 cm to 67 cm measured diagonally. The main parameters of the foreign tubes are given in a table. Some advice on tube replacement is given. Tube defects noted from operational experience are partial loss of emission by one or more cathodes, interelectrode short circuits (MEZ), vacuum loss and screen defects. Allowable defects in accordance with state standard GOST 26799-85 are explained and the standards are given in a table. Figures 4; tables 4.

Estimating the Range and Velocity When Probing With a Train of Optical Pulses

937K0149A Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 36, No 1-2, Jan-Feb 93 pp 17-25

[Article by A. P. Trifonov, M. B. Bespalova, Voronezh State University; UDC 621.396]

[Abstract] Optical pulse trains are used in optical detection systems. In this article the characteristics of the range and velocity estimates are examined taking into account the usual limiting factors: the time, pick power and energy of the probing train. Effects of the number of pulses in the train on the dispersion of the range estimates for a priory known target velocity is examined. It is demonstrated that the dispersion of the range estimates is a monotonically increasing function of the number of the train pulses. The maximum accuracy in estimating the range is obtained when using a degenerated probing train consisting of a single pulse. Using a train of N pulses for the range estimate is equivalent to increasing the intensity of the optical noise by a factor of N. This can lead to a significant decrease in the accuracy of estimating the range. Curves are provided showing the loss in accuracy of estimating the range and velocity as a function of the signal-to-noise ratio for different number of pulses in the train. Figure 1, references 4 Russian.

Optimal Amplitude-Phase Signal Processing After Detection

937K0149B Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 36, No 1-2, Jan-Feb 93 pp 47-55

[Article by B. N. Groznetskiy, A. L. Shteynberg, K. A. Kulikovskiy, Kiev Higher Engineering School of Military Aviation; UDC 621.391.519.23]

[Abstract] A combined processing of the envelope and phase for signal detection is discussed. This approach allows in many cases to replace the before-detector processing (in high frequency) by an equivalent after-detector processing, which is of a practical interest when employing the digital signal processing methods. The procedure of detecting a determinate signal with amplitude and angular modulation $s(t) = A(t)\cos(\omega_0 t + \varphi(t))$, where $A(t)$ and $\Phi(t)$ are its envelope and phase, in the presence of gaussian noise with a zero average and dispersion $\delta^2 = \Delta N_0$ is defined. It is assumed that the spectral noise density N_0 is uniform within the bandwidth of the linear path Δ and that the received signal is not subjected to any special processing before detection. It is demonstrated that the optimal combined processing of the envelope and the phase after detection is just as effective, in terms of the probability characteristics, as the optimal before-detector processing of the entire process. This supports the familiar assumption that the information of the observed process lies in its envelope and phase. The efficiency of the synthesized amplitude-phase detector is not different from a familiar detector with a quadrature processing. Figures 2, references 3 Russian.

Study of Fiber Optic Amplifiers Based on Stimulated Raman Scattering

937K0149C Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 36, No 1-2, Jan-Feb 93 pp 64-68

[Article by V. P. Daskalyuk, L. G. Zhuk, V. A. Ponomarenko, Kiev Higher Engineering School of Military Communications; UDC 621.391.052]

[Abstract] Results of modeling the propagation of optical radiation in a fiber optical amplifier (FOA) and the study of the relationship of its gain as a function of the single mode fiber optic lightguide (FOL) parameters are provided in this article. When a relatively high power optical radiation with frequency ν_1 is propagating in the FOA, a partial transition takes place to frequency $\nu_2(\nu_1 > \nu_2)$. This transition is explained by the Raman scattering, and the frequency difference is determined by the composition of the FOL materials. A method was developed for studying the FOA gain as a function of the FOL parameters and the pumping signals. Graphs are provided of Raman gain for different materials, fiber length and the pumping power. The experimental study indicate that the gain of the FOA based on Raman model depends on the FOL parameters and the ratio between the pumping power and the information channel at the input. Figures 6, references 7: 5 Russian, 2 Western.

Study of Scattering Characteristics of Arbitrarily Shaped Bodies of Revolution in a Quasi-Optical Region

937K0149D Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 36, No 1-2, Jan-Feb 93 pp 69-72

[Article by S. G. Grishchenko, Taganrog Radiotechnical Institute; UDC 537.874.4]

[Abstract] Methods of geometrical optics are used for the solution of the problem of electromagnetic wave scattering by electrically large, multilayer coated bodies of rotation with an arbitrary cross section, and the results are provided in this article. Quantitative estimates are made of the effective scattering surface (ESS) of spherical and ellipsoidal shape objects. The problem is formulated for the following conditions: A plane electromagnetic wave is incident at angle on a perfectly conducting body of rotation coated by K layers of magnetodielectric material with a complex permeability. The rotation axes of the coating interface surfaces are common with the axis of the body, and the lines which generates these surfaces are described by arbitrary smooth functions. The field scattered in the direction is determined as a sum of beams re-reflected from the coating layers and the body. The objective of the numerical analysis is to examine a feasibility of varying the ESS of the bodies of rotation by changing their shape and coating. It is demonstrated that an elongated shape of perfectly conducting bodies would significantly reduce the ESS. In addition, the ESS can also be reduced by 3 dB when the dielectric constant is increased by a factor of 2. Figures 2, references 5: 2 Russian, 3 Western.

The Period Doubling Phenomenon in a Quasi-Active Limiter on p-i-n-Diodes

937K0149E Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 36, No 1-2, Jan-Feb 93 pp 77-80

[Article by S. V. Krasovskiy, L. P. Rodina, D. A. Usanov, Saratov State University; UDC 621.372.854]

[Abstract] Experiments have been described in literature indicating that the dependence of the output power on the input power in quasi-active limiters on p-i-n diodes exhibits a hysteresis character. It was previously demonstrated that this phenomenon is accompanied by a generation of subharmonic components in the output signal, and that the generation of subharmonic components and hysteresis is related to the strongly manifested nonlinearity of volt-farad characteristic of the diode, whose capacitance together with the output inductance forms a series oscillating circuit. A mathematical model of a quasi-active limiter is developed in this paper which allows to theoretically describe experimentally observed generation of subharmonic components in the spectrum of its output signal. Figures 4, references 6 Russian.

Works by B. A. Vvedenskiy on Propagation of Ultrashort Radiowaves Along Earth Surface

937K0168A Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 577-592

[Article by N. A. Armand; UDC 621.371]

[Abstract] This article is dedicated to the memory of academician B. A. Vvedenskiy, whose 100th birthday will be observed on 19 April 1993. B. A. Vvedenskiy activity was in the area of experimental and theoretical studies on propagation of ultrashort radio waves (USW), (from centimeter to meter wave range). In his early works he experimentally determined that the USW field decrease is inversely proportional to the square of distance between transmitter and receiver. B. A. Vvedenskiy contributions to the development of domestic radiophysics are briefly outlined in this review, concentrating on his works related to the processes occurring with the USW propagation along the Earth's surface, their diffraction and refraction, including the phenomenon of far tropospheric propagation of radio waves. It is pointed out that the B. A. Vvedenskiy laid the foundations to the theory of USW propagation in the line of sight, as well as beyond the horizon. Computations of the USW field intensity can be made with sufficient accuracy using the relationships that he developed. He authored many scientific publications on propagation of the USW. Figures 5, references 43: Russian 22, Western 21.

Electrodynamics of Three Dimensional Integrated Circuits in the Microwave Range. (Review)

937K0168B Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 593-635

[Article by Ye. I. Nefedov; UDC 621.37]

[Abstract] Ideas, design methods, implementation and application prospects of three dimensional integrated circuits (TDIC) in the super-high (SHF) and extremely-high frequency (EHF) range are discussed. Role of the TDIC in the overall picture of constructing systems for a superfast information processing directly at SHF and EHF is demonstrated. A review is made of the principal types of the transmission lines used in the TDIC and their fundamental characteristics, the delay, losses, construction features, the area of application, etc are included. Physical models and methods for the TDIC mathematical modeling using new types of transmission lines are discussed. Examples of effective application of equivalent boundary conditions for the TDIC analysis are provided. A large section of the review is devoted to the results of an electrodynamic analysis of new original types of transmission lines for the TDIC. Impedance type slotted lines, dielectric lines with ribs, and non-symmetrical slotted lines with ribs are examined along with the familiar non- symmetrical slotted lines. The transmission lines analysis is performed by applying the Bubnov - Galerkin method, where the system of linear algebraic equations is reduced in the course of a numerical experiment. The computation results are comprehensively discussed from the point of view of applying these data for design and implementation of the superfast information processing system at SHF and EHF. Figures 27, references 100: Russians 57, Western 43.

Solution of a Problem of Diffraction by a Body of a Complex Configuration and Large Electrical Dimension Using Integral Equations Method

937K0168C Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 636-641

[Article by D. D. Gabrielyan, M. Yu. Zvezdina UDC 537.874.6.01]

[Abstract] Approximation of the surface current density is proposed and expressions are obtained for the directional pattern, which significantly reduces the computation volume when solving the problem of diffraction by perfectly conducting bodies of arbitrary configuration and large electrical dimensions using integral equations method. An approach is described which yields a qualitatively accurate description of the boundary waves, and the numerical determination of the expansion coefficients makes it possible to correctly determine their amplitudes. For nonbulging bodies this method can not be applied in the following situations: first, when there are concave sections of the curvilinear surface, and second, when the bondary between the illuminated and shaded areas falls on a rectilinear section of a wedgelike depression. However, this method is valid when the wedgelike depression is either completely illuminated or shaded. Computations were made of the surface current distribution and the directional pattern with diffraction of the planar wave by different bodies and the results are shown in a graph. Figures 2, references 11: 10 Russian, 1 Western.

Depolarization of Electromagnetic Waves When Scattered by the Heterogeneities of Dielectric Permittivity

937K0168D Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 642-647

[Article by T. I. Aliyeva, V. D. Gusev; UDC 550.388.2]

[Abstract] A solution is proposed to the problem of electromagnetic wave scattering by the heterogeneities of dielectric permittivity using Hertz vector without limitations on the type of the scattering volume and the field property at its boundary. Depolarization problems of the average field are examined when it is scattered by anisomeric heterogeneities of dielectric permittivity. It is demonstrated that when studying the wave polarization in a heterogeneous medium one can not be limited by Born's approximation, but must take into account the depolarization of the average field due to scattering by anisomeric heterogeneities of the medium. In the case of waves in the meter range, with intensive fluctuation of electron concentration and strong anisomerism of the heterogeneities in the ionosphere, depolarization of the average field due to scattering becomes commensurable with depolarization due to the medium's gyrotropy. References 5: 4 Russian, 1 Western.

The Limiting Characteristics of Angular Super-Resolution of Antenna Arrays When Monitoring Coherent Sources

937K0168E Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 648-652

[Article by I. V. Gankov; UDC 621.372]

[Abstract] Resolution of coherent point sources is examined as they are monitored by an expanded antenna array. Super-resolution characteristics of two coherent sources emitting harmonic signals with a constant phase difference between them are determined by applying the reversing method, the Proni decomposition, and the combination method. For the latter two methods, the size of pre-sampling, yielding a maximum resolution is estimated. It is demonstrated that the combination method produces the best results, approaching the Kramer-Rao limit in the order of magnitude. This is explained by a higher degree of decorrelation than with the purely reverse processing, and greater length of pre-sampling than with the trivial Proni decomposition. Figures 2, references 9: 6 Russian, 3 Western.

An Experimental Study of the Efficiency of Adaptive Spatial Compensation of Unintentional Interferences at Shortwave Radar Stations for Remote Diagnostics of the Sea Surface

937K0168F Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 4, Apr 93 pp 664-672

[Article by Yu. I. Abramovich, F. F. Yevstratov, V. N. Mikhaylyukov; UDC 621.396.67]

[Abstract] Results of experimental testing of the efficiency of adaptive compensation methods of unintentional interferences in shortwave radar stations for remote diagnostics of the conditions of the sea surface are described. Special algorithms for adaptive spatial compensation are developed, assuring a high efficiency of suppressing spatial transient interferences and providing conditions for a coherent reception of useful signals which retain their doppler spectrum undistorted. It is demonstrated that under high-load conditions of the frequency band, application of the adaptive spatial filtering can provide high quality estimates of the signal's doppler spectra, reflected from the sea surface which determine its hydrologic condition. Figures 6, references 5: 2 Russian, 3 Western.

Spatially Restricted Wave Beams With a Minimal Divergence

937K0159A Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 3, Mar 93 pp 385-393

[Article by V. V. Lebedeva, M. I. Orlov, R. I. Sokolovskiy; UDC 621.372.812]

[Abstract] The problem of a wave beam diffraction, limited by a diaphragm, is solved by applying a parabolic approximation, and expressions for field amplitudes in the plane of the source are obtained. This involves a solution of the variation problem of finding the least diverging wave beams with specified parameters - the number of nodal lines, shape and dimensions of the diaphragm or the source and the rms radius. The beams with a minimal divergence are characterized by a maximum concentration of energy to the beam axis in the far zone. It is demonstrated that the Gauss - Hermite and Gauss - Lagger wave beams constitute a particular case of the solution for unrestricted opening of the diaphragm. The obtained expressions can be applied in development of spatial amplitude filters for instruments with minimal scattering of energy, and also for systems of channeling or transferring of energy at large distances in free space. Figures 5, references 17: 8 Russian, 9 Western.

Reflection of Radiowaves From the Ocean Surface Obtained by Bistatic Radar Sensing Using Two Satellites

937K0159B Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 3, Mar 93 pp 447-453

[Article by S. G. Rubashkin, A. G. Pavelyev, O. I. Yakovlev, A. I. Kucheryavenkov, A. I. Sidorenko, A. I. Zakharov; UDC 528.8.044+528.813]

[Abstract] Results of bistatic radar sensing of the ocean in the decimeter wave range using two Earth satellites are described. One of the satellites, the orbital, contained a source of monochromatic radiation in the decimeter range, the other, a geostationary satellite, contained a radiowave receiver. The essence of bistatic or two-position sensing consists ofn employing a frequency selection for finding spatial resolution of direct and reflected signals. Relationships are obtained for the integral reflection coefficient from the ocean surface as a function of the radiowaves grazing angle; the signals energy spectrum characteristics are investigated and some parameters of the ocean agitated surface are determined. Figures 5, references 5: 2 Russian, 3 Western.

Parasitic Low-Frequency Oscillations in the mm-Wave Gunn Oscillator

937K0159C Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 3, Mar 93 pp 536-538

[Article by I. A. Kravtsov, A. V. Meshcheryakov; UDC 621.382.029.64]

[Abstract] Effects of the power supply voltage and the ambient temperature on the spectrum of the output oscillations of a Gunn diodes oscillator (GDO) are examined. It is demonstrated that the development of a multiple frequency mode of the GDO operation is related to excitation of parasitic low frequency oscillations in the diode power supply circuit and their modulation of the output microwave signals. The scenario of the low frequency and microwave oscillations spectrum transformations with changes in the power supply voltage are similar to the scenario observed in the centimeter wave oscillators. When the ambient temperature is decreased, the range of the power supply voltages, where the monochromatic generation mode is observed, shifts into the region of higher voltages, and at $t < 0$ exceeds the limits of maximum tolerable values. Application of an antiparazitic circuit would expand the range of the monochromatic mode in terms of power supply voltage as well as temperature. Figures 2, references 11: 9 Russian 2 Western.

The Feasibility of Short Gunn Diodes Operation on GaAs at a Temperature of Active Region Above 500 K

937K0159D Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 38, No 3, Mar 93 pp 553-556

[Article by Yu. V. Arkusha, N. Ye. Polyanskiy, E. D. Prokhorov; UDC 621.2]

[Abstract] Operation of short GaAs Gunn diodes at temperatures of the active region above 500 K was examined theoretically and experimentally. Of prime interest were the ultimate temperature capacities of the Gunn diodes in the mm-range. The temperature of the active varied from 300 to 700 K. It was assumed that there are no temperature gradients in the diode active region; the diode generated temperature was not taken into account, which corresponds to the operating condition of the diode in the pulse mode of operation. The fundamental computations and experimental results are provided. It was demonstrated that the GaAs Gunn diodes with the length of the active region upto 2.5 mm can function at temperatures of the active region of about 650 K. With a shorter length of the Gunn diode active region (smaller then 2.5 mm), the maximum temperature of the diodes functioning is reduced to 500... 550 K. As the temperature of the active region is increased, the upper frequency limit of the Gunn diode operation at the frequency of the fundamental harmonic is decreased (from 150 GHz at 500 K down to 110 GHz at 600 K). Capacity of the Gunn diodes performance at temperatures of the active region up to 600 K was demonstrated experimentally. Figures 4, references 4 Russian.

Calculation of Characteristics of Random Access to Switched Communication Relay by Method of Equilibrium Points Analysis

937K0154A Moscow RADIOTEKHNIKA in Russian No 12, Dec 92 (manuscript received, after completion, 5 Aug 91) pp 7-13

[Article by I.K. Vildyayev and I.S. Pakhomov; UDC 621.396.234.519.87]

[Abstract] Use of communication relays with multiple-beam antennas is considered, switching such a relay making it possible to ensure a link between zones covered by different antenna beams. The stochastic characteristics of message traffic over a satellite communication network which includes such a relay and operates in accordance with the R-ALOHA random multiple access protocol are calculated by the diffusion method of equilibrium points analysis, this method being particularly applicable to this case of catastrophically fast increasing power in the state space. The functioning mode is assumed to be that of packet radio network with a number of antenna beams equal to or larger than that of relay trunks, all ground stations covered by any beam via "up" and "down" lines using a common R-ALOHA channel. A high-speed digital computer presumably processes incoming data packets for detection of "colliding" ones and, in the case of successful reception of a packet, identification of its target zone. In this way the computer controls the relay switch and a packet, if it has "collided" with another one, is with a certain probability retransmitted. Calculations on the basis of the packet radio model with a relay switch yields the equilibrium condition for the standby state in any one antenna beam, this condition involving the average number of successfully transmitted packets per frame in that beam. A subsequent numerical analysis of the dependence of this number on the intensity of the incoming message flux indicates that the R-ALOHA protocol diminishes the throughput capacity of a satellite communication network with a switched multiple-beam relay to below that of one with a single-beam relay not requiring an on-board switch and, furthermore, lengthens the message transmission delay. A special protocol is, therefore, needed here which will include an algorithm of on-board switching control and will maximize the probability of a packet passing through that switch. The performance will be further enhanced by control of the retransmission delay following a "collision" of packets. Figures 7; references 5.

Probability of Detecting Elongated Objects

937K0154B Moscow RADIOTEKHNIKA in Russian No 12, Dec 92 (manuscript received, after completion, 17 Aug 91) pp 13-18

[Article by V.A. Ponkin and I.M. Zuyev; UDC 621.396.96]

[Abstract] Approximate analytic expressions are derived for detection of elongated objects by radar. Probability of their detection is dependent on their dimensional characteristics and the radiation pattern parameters of the radar antenna. As the original signal is selected as a continuous or discrete function Y(r) of an n-dimensional vector r, this function is defined in the search region D of incoming signals and describes the image of such an object. The maximum-likelihood decision about presence or absence of such an object is based on processing the input signals S(r) from the target along with background noise N(r) covering the entire search region, assuming: 1) exponential probability distribution functions of post-detection signal power and noise power in the radar receiver, 2) highest possible resolution and mutual independence of signals reflected by different resolvable object elements, 3) high resolving power of the (idealized) radar set. The probability of correct detection is shown to depend not only on the dimensions of an elongated object and its contrast but, when its dimensions exceed the radar resolution, also largely on its form. This is demonstrated by comparing detection of a square object and a rectangular one, the probability of correct detection being lower in the second case. Increasing the resolving power of the radar set will evidently also increase the signal-noise ratio of its data processing system, owing to a smaller contribution of resolution elements at the "object-background" boundary. The elements of the object at that boundary then will, as the more diffuse image of the object indicates, have a milder contrast than those within its core. Figures 2; reference 7.

Use of Transposition and Spectrum Convolution for Study of Digital Signal-Processing Devices

937K0154C Moscow RADIOTEKHNIKA in Russian No 12, Dec 92 (manuscript received, after completion, 30 Sep 91) pp 28-30

[Article by A.I. Tyazhev; UDC 621.372.56]

[Abstract] Use of transposition and spectrum convolution operations for performance analysis of digital signal-processing devices is demonstrated on a digital rectifying amplitude detector, transposition of time discretization by the sampling-and-storing device and level quantization by the analog-to-digital converter being considered here. A rigorous description of the signal spectrum at the output of an analog-to-digital converter behind the sampling-and-storing device would be difficult or even impossible, inasmuch as nonlinearity of the quantization characteristic further enriches the signal spectrum in the analog-to-digital converter after not only nonlinear distortions but also multiplication of the spectrum and superposition of multiplied spectrum segments have already taken place in the sampling-and-storing device. When an alternating signal x(t) appears at the input of a digital rectifying amplitude detector, then readings x(n) with alternating signs appear in successive discretization periods at the output of its analog-to-digital converter with a sampling-and-storing device. These readings proceed to an ABS ("absolute value") unit, at whose output then appear signal moduli | x(n) | of one sign only. When the input signal alternates sinusoidally at a frequency f, then the spectrum of the output signal will consist of constant component and a ripple of harmonics. Both minimum and maximum magnitudes of the constant component depend on the ratio m= F/f of discretization frequency F to signal frequency f. Calculation of these two magnitudes based on this method of analysis reveal that a parasitic amplitude modulation takes place in the detector. Detection of amplitude-keyed signals becomes possible when m= 5 and detection of also amplitude-modulated signals is possible when $m \geq 9$. Figures 1; tables 1; references 3.

Direction Finding of Wideband Signals by Suboptimal Maximum-Likelihood Method

937K0154D Moscow RADIOTEKHNIKA in Russian No 12, Dec 92 (manuscript received 14 Jun 91) pp 31-33

[Article by E.A. Maltsev; UDC 621.391]

[Abstract] Two modifications of direction finding by the suboptimal maximum-likelihood method are proposed for use on wideband incoming signals. Both are demonstrated on the simple case of only two such signals simultaneously arriving at the receiver antenna from different directions. In the original method these directions are found after preliminary estimates have been made using any of the superhigh-resolution direction finding algorithms, the classification of signals method (MUSIC) algorithm appropriately considered here. Both modifications of this method involve frequency averaging, which yields better estimates than those obtained by other methods of wideband processing. The first modification is frequency averaging by coherent processing, which demands lengthy computations but does not require a priori information about the directions of incoming signals. The algorithm of second modification is shorter and does not include preliminary estimation of those directions. The spatial spectrum of signals is in each case calculated by the Bartlett method. A comparative analysis by mathematical simulation of the two proposed wideband processing algorithms and the narrow-band processing algorithm of the maximum-likelihood method indicates that both modifications are highly efficient under conditions of small sampling volumes, numerical calculations having been made for two signals having each a relative bandwidth of 0.2 and B arriving at an antenna array at incidence angles of 50° and 55° respectively. References 3.

Characteristics of Radio Signals Subject to Reflection by Ionosphere

937K0154E Moscow RADIOTEKHNIKA in Russian No 12, Dec 92 (manuscript received 23 Sep 91) pp 49-52

[Article by S.V. Zhuravlev, V.Ye. Kunitsin, and A.B. Usachev; UDC 537.874]

[Abstract] Vertical passage of radio waves through a stratified isotropic ionosphere with an arbitrary vertical profile of electron concentration and effective collision frequency is considered, the complex transmission coefficient for such waves being calculated by referring to only one ionospheric layer. The method of calculation is based on the Helmholtz equation for the electric field E(z) of a scalar wave in such a ionosphere (z- vertical coordinate), with the Laplacian of E (function of z-coordinate only) equal to $[q(z)- k^2]E$ (k- wave number). The complex function q(z) in this equation is analogous to the potential in quantum mechanics. The complex transmission coefficient is defined as the field amplitude at the upper boundary z_u of a given layer and then in terms of the variable $V(z,f)= dE(z,f)/E(z,f)dz$ (f- frequency of radio wave). The complex reflection coefficient is calculated after the Cauchy problem has been solved by numerical methods over an entire layer within its z_d lower and z_u upper boundaries. The complex transmission coefficient is calculated after V(z) has been obtained, in terms of the Heaviside unit-step function, from the exact solution to the problem of reflection by a δ-potential for any layer whose thickness is much smaller than the wavelength of the incident radio signal. The method is demonstrated on two widely different ionospheric layers: 1) a smooth 100 km thick parabolic F-layer passing radio waves whose frequency is near the 10 MHz critical one; 2) a smooth 3 km thick layer simulating an E_s layer with a parabolic top and sloping edges approximately simulated by cubic splines, the electron concentrations along its edges being large (average 2.1×10^6 $cm^{-3}km^{-1}$) and the critical frequency for passage of radio waves being 4.915 MHz. Wave phenomena such as interference as well as absorption are shown to influence both coefficients appreciably when sounding of the ionosphere is done with radio waves whose frequency is near the critical one and thus either suprabarrier reflection or tunneling takes place. Calculation of the transmission at successive instants of time is shown to reveal distortions of a radio pulse passing through an ionospheric layer as, for instance, those of a bell-shaped pulse of 10 μs duration riding on a 5 MHz carrier through a 3 km thick E_s layer. Figures 3; references 6.

The Pathogenic Effect of Electromagnetic Waves

937K0172A Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 3, Mar 93 pp 20-22

[Article by A. M. Kostrominov, T. V. Kalyada, V. N. Nikotina; UDC 658.382.2:656.2]

[Abstract] Biotechnical electromagnetic compatibility (EMC) as a property of any biological object (in particularly human) to preserve normal functioning under conditions of electrical, magnetic or electromagnetic impact of any technical sources on the object during its life-cycle without shortening it, is examined. The state of the problem is reviewed including the pathogonic effects of electromagnetic radiation on men. Tables are compiled based on a domestic study, describing the problem of biotechnical EMC in the frequency spectrum and the type of electromagnetic effects. Applying clinical and physiological methods it was demonstrated, that the Electromagnetic radiation (EMR) produces distinct changes in the health of persons professionally connected with the EMR sources, as well as the general population. A high vulnerability is recorded of the central nervous system, disorder in the functioning of the endocrine sytem, depression of immunogenesis, damage of the cardiovascular system, negative changes in sexual and a number of other functions. Radiation normalization problem of persons having contact with the EM sources is discussed. Tables 2, references 7: 5 Russian, 2 Western.

On-Board Devices for the Gravity Hump Automatic Locomotive Signalling System With Information Transmission by the Rail Circuit

937K0172B Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 3, Mar 93 pp 5-11

[Article by A. G. Savitskiy, Ye. K. Gurin; UDC 658.257.83:656.212.5]

[Abstract] On-board equipment for the gravity hump automatic locomotive signalling where information is transmitted by the rail circuits is intended for receiving and decoding codes—commands delivered to the locomotive, for displaying the received information, controlling the automatic stop circuit, and also for issuing assignments on speed to the equipment which regulates the electric locomotive speed. The composite parts of the equipment are described. The design of the on-board devices is developed for the most common maneuvering electric locomotive of the Commonwealth of Independent States railroads, the ChME3 type and its modification ChME3E. The power supply source unit, the composition of the locomotive receivers, and the control and signalization units are comprehensively described and the block diagrams of their electrical circuits are provided. Safety devices for checking the locomotive operator alertness and their functioning are also described. Figures 6.

Organization and Development of Information Communication at the South-Ural Railroad

937K0166A Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 1, Jan 93 pp 29-31

[Article by G. I. Dadov, O. P. Poluektov]

[Abstract] Communication problems at the South-Ural railroad are discussed. At the present time equipping the railroad with telephone communication is held back by problems in the overall development of the computer technology. Therefore, telegraph communication is still widely used, as the most inexpensive method of data transmission. A diagram shows organization of the telegraph communication with other railroads. In 1989 the secondary multiplexing equipment TT-144 was introduced, and in 1991 it was possible to start transmitting the main flow of information at the rate of 100 bit/sec. The telephone channels are used for exchanging information between traffic control centers. A diagram is provided showing the existing organization of communication between remote-controlled processing systems and the automated traffic control centers. However, the rate of railroad communications development is falling behind the requirements of computer technology: an overall and full implementation of new and existing projects, such as "Ekspress-2", Automatic Traffic Control Centers, etc is not provided. Significant capital investments are needed for the development of the communication, cable laying, and procurement of equipment.

Reconditioning of the Mainline Communication Cable

937K0166B Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 1, Jan 93 pp 32-33

[Article by S. I. Smolikov]

[Abstract] Explosion technology is now employed for installation of aluminum couplers of the mainline communication cable at the Skovorodinskiy section of the Beyond-Baykal railroad. Beginning with 1988, cable laying teams started installation of the couplers employing only this advanced technology. Compared to the soldering or pressing methods, which were used before, the speed of installation has increased. Because of diffusion of the coupler's aluminum into the aluminum of the shell, the reliability of contact between the aluminum coupler and the aluminum shell of the cable is almost perfect. Mechanical strength of this coupling is greater than the aluminum shell or the coupler, and because two identical metals are being fused, there is no local electrical corrosion. In 1989 courses were organized at the special branch of Blagoveshchensk Polytechnical School for training cable laying personnel in explosion welding technology. Explosion specialists for managing explosion works on the mainline communication cable are graduating annually from the school.

The Satellite Communication System "Sirius" of the Ministry of Railroads

937K0165A Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 2, Feb 93 pp 2-8

[Article by Ye. F. Kamnev, A. S. Belov, V. A. Pankov, G. F. Lekuta, I. A. Zdorovtzov]

[Abstract] The satellite communication system "Sirius" of the railroads ministry is described. The system is intended for organizing the required number of channels for the primary network of communication between the railroad ministry's administration and railroad departments via domestic satellites "Horizont", and for providing a stable operation of the existing communication network (especially under emergency conditions) due to its redundancy by the space communication facilities. The composition of the system, its fundamental characteristics, organization of the satellite communication networks and the economic aspects are discussed. The system would provide: a practically unlimited communication range; independence of the quality and cost of channels on the distances between the control stations and the railroad; high quality and transmission capacity of the channels, etc. The "Sirius" system is a composite part of the railroad ministry's overall communication network, whose structural interaction with the existing network is shown in a diagram. Block diagrams of a satellite communication station, and its fundamental technical characteristics are also provided. It is projected that a trial section (Siberian railroads and the first phase of the central satellite communication unit in the Moscow region) will be put in operation in the first half of 1993. The completion of the system is scheduled for 1995-96.

Structure of the Railroad Telegraph Communication Network

937K0165B Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 2, Feb 93 pp 11-13

[Article by N. F. Semenyuta, G. I. Shchuplyakova, A. N. Semenyuta; UDC 656.254.14]

[Abstract] An analysis is made of problems dealing with the structure of automatically commutated telegraph communication (ACTC) network for railroads. Two interrelated problems are discussed: location of the interchanges, and configuration of the subscriber's and the inter-station's network. This involves solving the problem of selecting the commutation methods, capacities of the interchanges, the size of channels, etc. At the present time the network consists of a complex, widely expanded system of electrical communication facilities. It is intended for information support of freight and passenger transportation, planning and control of the transportation process. The ACTC network structure, reflecting the control hierarchy of the railroad transport is described, and a question is posed: which structure of the telegraph communication best satisfies the contemporary state of the art in development of electronic communication facilities and the system for controlling the railroad transport. Figures 3.

Telephone Loads of the Automatic Channels of the Railroad's Mainline Communication Network

937K0165C Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 2, Feb 93 pp 14-15

[Article by Yu. V. Yurkin, A. P. Pavlovskiy, A. K. Lebedinskiy, P. V. Anpilov; UDC 656.254.153]

[Abstract] Telephone loads of automatically commutated railroad telephone network mainline channels were measured and analyzed and the results are listed in a table. Measurements of the telephone loads and indicators of the service quality were made for automatic channels of the railroad ministry's mainline in October 1991. Data were obtained on telephone loads during peak hours, probability of lost calls, and the average time of calls. The measurements were made from an automatic telephone exchange located at the central communication station of the railroad ministry. The Ionin - Sedov algorithm was used for determination of the load values. Tables 3.

Program Model of Locally Optimal Planning of Parallel Computations

937K0173A Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 93 pp 20-24

[Article by V. N. Kustov and A. I. Bagrich, candidates of engineering sciences, Military Engineering-Space Institute, Saint Petersburg; UDC 519.8]

[Abstract] As the growth in productivity of traditional computers has declined, interest in parallel processing has increased. To take advantage of parallel processing, the problem of planning parallel computations must be solved. One approach is to use the methods of scheduling theory. The problem of designing locally optimal non-delay schedules for homogeneous multiprocessor computer systems was discussed. An algorithm for locally optimal planning based on modifying the method of dynamic programming was presented. An example of implementation of the algorithm and analysis of results of statistical modeling were presented. Results of modeling showed that in 85 percent of the cases the method of locally optimal planning allows finding schedules, optimal by the criterion of the efficiency function, and in the remaining cases the divergence between the solution obtained by this method and the optimal solution obtained by the method of dynamic programming did not exceed 8 percent. Figures 4; references 6: 6 Russian.

Modeling of Radio Reconnaissance System Functioning Process. II. Radio Reconnaissance System Model

937K0173B Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 93 pp 45-49

[Article by S. A. Karpov, junior scientific associate; Part I was published in No 6, 1992; UDC 621.396.96;621.391.26]

[Abstract] An analytical expression for quantitative evaluation of the partial indicator of the effect achievable by the use of a radio reconnaissance system was derived based on a description of the process of propagation and loss with continuous time. Algorithms for subsystems for detection, automated processing and control, radio observation and direction finding were presented as queuing systems. The expression may be used in solving problems of estimating the operational efficiency of a radio reconnaissance system given the parameters of radio equipment and radio communication subsystems. It can also be used in assessing the effectiveness of introducing specific engineering solutions and taking organizational measures aimed at enhancing safeguards of radio equipment and radio communication subsystems against reconnaissance. References 10: 9 Russian, 1 Western.

Modeling of Methods of Reception of Multipositional Signals

937K0173C Kiev ELEKTRONNOYE MODELIROVANIYE in Russian No 1, Jan-Feb 93 pp 72-74

[Article by P. F. Petrov and V. V. Pus, candidates of engineering sciences, Saint Petersburg Department of the NII [Scientific Research Institute] of Communications; UDC 621.391.2]

[Abstract] Statistical tests using the Monte-Carlo method were used to estimate the efficiency of the optimal criterion of classification of multipositional incoherent orthogonal signals. The criterion is invariant to the intensity of Gaussian noise. The efficiency of quasi-optimal criterion analogs which allow a simpler engineering implementation was also estimated. Use of the simplified statistics, the sum and weighted sum of the moduli of quadratures, was accompanied by a slight loss in reception efficiency. References 4: 4 Russian.

Optimal Linear Correction of Elliptical Orbits

937K0161A Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 3, Mar 93 pp 93-101

[Article by R. R. Nazirov, T. A. Timokhova, Russian Academy of Sciences Institute of Cosmic Studies; UDC 519.714]

[Abstract] The analytical optimization problem of pulsed linear correction of the parameters of a space vehicle elliptical orbit is solved for the conditions when the correcting pulse is produced by the engines acting in the directions along the velocity vector, perpendicular to the velocity vector, and along the normal to the orbit. An elliptical orbit is examined with eccentricity e ($0<e<1$). Unlike the previously developed numerical solutions for the optimization problem of pulsed linear correction of a space vehicle orbit parameters, a complete analytic solution is obtained in this study for a wide class of orbits. Restrictions for the value of eccentricity are not significant since they are near unity, and the eccentricity of most real orbits of the cosmic vehicles is much smaller. References 5 Russian.

Kinetic Modeling of the GaAs P-Channel Field Effect Transistor

937K0148A Moscow MIKROELEKTRONIKA in Russian Vol 22, No 2, Mar-Apr 93 pp 9-14

[Article by V. A. Pankratov, V. I. Ryzhiy, Russian Academy of Sciences Physical Technology Institute; UDC 621.382]

[Abstract] Based on a kinetic approach, a numerical modeling was conducted of p-channel heterostructure GaAs field effect transistor in the submicron range. It was demonstrated that the hole plasma of the modeled transistor is unbalanced and that the relationship between its parameters and the electric field intensity is non-local; the hole transfer has essentially a two-dimensional character. The gate leakage current greatly depends on the gate potential and causes a significant lowering of the slope when the gate potential is 0.4 V. The gate current density can have two maxima: the first, fundamental, is determined by the gate potential; the second, which is less pronounced, by the drain potential. Figures 5, references 12: 4 Russian, 8 Western.

GaAs Surface Oxidation With Vacuum Ultraviolet Purification in Air

937K0148B Moscow MIKROELEKTRONIKA in Russian Vol 22, No 2, Mar-Apr 93 pp 50-52

[Article by K. A. Valiyev, L. V. Velikov, A. N. Ponomarev, I. A. Ryzhikov, S. M. Fedotov, Russian Academy of Sciences Physical- Technology Institute; UDC 541.144]

[Abstract] Data are provided of the results of a study of the GaAs vacuum ultraviolet purification processes in the O_2 medium (in air). A D_2-discharge lamp with electric power of 500 W was used. This lamp delivered 30 mW/cm^2 power in the 115-200 nm range. The purification process from carbon containing compounds was accompanied by a modification of the surface layers. This was controlled by the surface Auger-spectrum, and also by the volt-ampere (VA) characteristics. For GaAs, the VA behavior is related to the formation of about a 3 nm thick layer of Gallium oxide. Figures 2, references 4: 3 Russian, 1 Western.

Magnetoresistive Memory Elements

937K0148C Moscow MIKROELEKTRONIKA in Russian Vol 22, No 2, Mar-Apr 93 pp 64-71

[Article by V. O. Vaskovskiy, V. G. Mukhametov, P. A. Savin, V. V. Strelok, Ural State University, Scientific Research Institute of Physics and Applied Sciences; UDC 621.382]

[Abstract] Production technology was developed and the relationships governing the remagnetization of thin-film single-layer and double-layer memory elements functioning on the principles of magnetic recording and magnetoresistive information read-out were studied. The effect of the film thickness on the formation conditions of different magnetic states in the single-layer spear-shaped elements was determined and it was demonstrated that the strongest read-out signal (up to 1 mV) is formed when using the states with a different polarity "neyelev" domain boundary. The relationship between the properties of the original films, the geometry and hysteresis characteristics of the two-layer elements, whose application allows to simplify the recording control system - the information read-out, was analyzed. The conditions for a stable existence and threshold switching of states, which differ by the circulation direction of the quasi-shortcircuited magnetic flux, were determined. A read-out signal up to 0.15 mV was obtained. Figures 6, references 7: 4 Russian, 3 Western.

Adequate Device-Circuit Modeling of the Current Switches Using Submicrometer Inversed Transistor Structures

937K0148D Moscow MIKROELEKTRONIKA in Russian Vol 22, No 2, Mar-Apr 93 pp 85-95

[Article by A. N. Bubennikov, B. O. Nakropin, N. I. Filatov, Russian Academy of Sciences Cybernetics Institute, Russian Institute of Information Systems; UDC 621.382]

[Abstract] Using numerical two-dimensional device-circuit modeling (DCM) the transient processes were examined in super-fast acting current switches employing sub-micron inversed transistor structures. Employing the DCM methods, the problems are studied of the effects of the impurity distribution and the geometry of small profile inversed transistor structures, the effects of high-level injection of non-steady state current displacement on the processes of non-symmetric and symmetric switching, as well as fast acting of non-saturated elements employing a single phase and para-phase current switches. Figures 8, references 13: 9 Russian, 4 Western.

Parallel Digital Neurocomputer Realization of Models of Neuron Networks, Trained by the Method of Reverse Propagation of the Error

937K0141A Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 14, No 6, Nov-Dec 92 pp 14-19

[Article by G. A. Galuyev, Scientific Research Institute for Multiprocessor Computer Systems at Taganrog Radioengineering Institute; UDC 007.57]

[Abstract] The algorithm for training neuron-like networks by the method of reverse propagation of errors is examined and the feasibility of its parallel realization on the basis of neurocomputations is analyzed. A parallel neurocomputer realization of reverse propagation neuron-like networks based on digital neuron processors is proposed. The fundamental results of this study lie in the assertion that a three-layer network, which has two layers of trained elements can realize any logic function of N variables, including the most complex of them the " excluding OR" function, which is characterized by the fact that the vectors of the same class are orthogonal, and the vectors of different classes are non-orthogonal. The solution of this problem is reduced to a search of the required values of wight coefficients of all trained elements of the neuron-like network. The examined method of reverse propagation of the error is used for the solution of this problem. The results obtained in this study make it possible to carry out a parallel neurocomputer realization of the method, which constitutes a base for development of parallel digital neuroncomputers, trained by the method of reverse propagation of the error. These computers would provide an effective solution of many applied image recognition problems in a real time mode. Figures 4, references 6: 2 Russian, 4 Western.

Modeling of the Functioning Process of Radio Reconnaissance. Part 1. Model of the Radioelectronic Situation

937K0141B Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 14, No 6, Nov-Dec 92 pp 44-48

[Article by S. A. Karpov, Kiev Higher Military School for Communications Engineers; UDC 621.396.96;621.391.26]

[Abstract] A descriptive model of a system of radio reconnaissance is developed based on the familiar algorithms for functioning of automated radio surveillance systems operating in an self-sufficient and centralized mode. The system consists of detection, monitoring, location and automatic processing and control subsystems. The detection subsystem includes n receivers conducting a continuous search of radio signals in an assigned frequency range. A continuous origination and destruction process with a discrete multitude of states (a condition where k radiation sources are acting in the zone of the system responsibility) is described, and an analytical expression is obtained for determination of the number of simultaneously radiating sources. The model is intended for statistical computer modeling. References 12: 9 Russian, 3 Western.

Railway Ministry Satellite Communications System Detailed

934E0582A Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 2, Feb 93 pp 2-8

[Article by Ye. F. Kamnev, director of the Moscow Communications Scientific Research Institute, corresponding member of the Russian Academy of Sciences, professor and doctor of technical sciences; A. S. Belov, senior scientific associate of the Moscow Communications Scientific Research Institute, chief designer and candidate of technical sciences; V. A. Pankov, chief specialist of the Moscow Communications Scientific Research Institute; G. F. Lekuta, chief of the Signals, Communications and Computer Technology Administration of the Russian Federation Ministry of Railways; and I. A. Zdorovtsov, deputy chief of the Signals, Communications and Computer Technology of the Russian Federation Ministry of Railways and candidate of technical science: "The Ministry of Railways' Sirius Satellite Communications System"]

[Text]

1. The System's Purpose and Area of Application

1.1. The MPS' [Ministry of Railways] Sirius Satellite Communications System [SCS] is intended for the organization, by the most efficient method, of the necessary number of channels of a primary communications network between the MPS and the railroads' administrations and divisions via the domestic Gorizont [Horizon] satellites and for ensuring the stable operation of the existing communications network (especially in emergency situations) by backing it up using space-based means of communication. It ensures:

—a practically unlimited communication range;

—the non-dependence of the quality and cost of the channels on the distance between the ground stations (ZS) of the railroads' administrations and divisions;

—a high level of quality and carrying capacity for the communications channels, including even under conditions specific for the railroads;

—the transmission of conference calls to a large area of coverage.

Provision has been made in the system for the modular construction of ground stations, which provides a step-by-step increase in their channel capacity through the additional delivery of communications and cable equipment. Provision has also been made for the possibility, using software, of rapid reallocation of the dedicated communications resource of a space vehicle among users in accordance with the actual needs of the railroads and with consideration of the time zone.

The organization of the construction makes it possible to improve and to develop further the SCS based on the extent of the placement into service of promising space vehicles like the Ekspress [Express] craft.

1.2. The Sirius system, based on the channels of the primary network, makes it possible to organize secondary networks of geosynchronous satellite communications, ensuring:

—the exchange of general service telephone and telegraph information of the Ministry of Railways with the railroads' administrations, as well as between the railroads' administrations themselves and between the administrations and their own divisions and large stations;

—the intercomputer exchange of data from the Ministry of Railway's GVTs [Main Computer Center] and the computer centers of the railroads' administrations and divisions and large stations between one another in accordance with the structure of the data network;

—the intercomputer exchange of data between the regional computer centers of the Ekspress-2 system;

—and the exchange of documentary (telefax, telex and others) information at all levels of the network.

All communications services are rendered over dedicated and switched digital channels with a transmission rate of 9.6/16 kbit/s [kilobits per second], the parameters of which comply with domestic and international norms.

1.3. The Sirius system is a component of the Ministry of Railways' general communications network, the structural interaction of which with the existing communications network is depicted in figure 1.

The structure contains basically the primary satellite network of the Sirius SCS, the limits of which are the ground stations of the railroad and division centers. Entry into the Ministry of Railways' communications network and the state network is accomplished through the existing centers of the ground network.

Taking into account the non-dependence of the cost and quality of the satellite communications channels on their extent, the greatest effect from the use of the Sirius system must be expected from the communications links with the administrations of the Ural, Siberian, Far Eastern, Central Asian and Transcaucasian railroads.

Under the existing conditions of the functioning of the economy, when the prices for cable products and multiplexing equipment have increased by factors of 10-20, satellite communication is an efficient means of organizing mainline and railroad communications even for the central (European) regions of our homeland. This is why, in the procedure for defining more precisely the technical and economic indicators of a satellite communications system developed for the first time in the interests of the railroads, it has been proposed that a satellite communications fragment made up of remote and nearby (relative to the Sirius system's central center) railroads be developed in 1992 and placed into service in the first half of 1993.

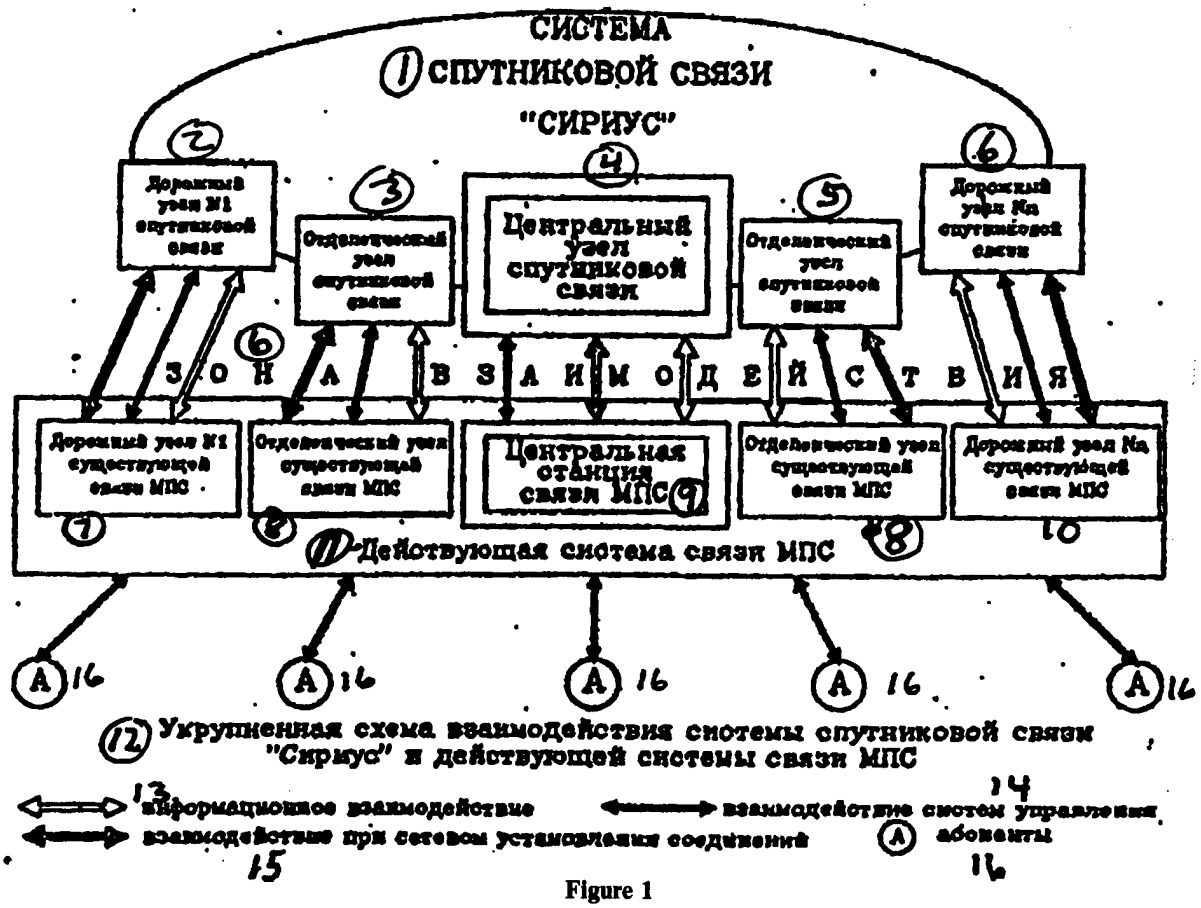


Figure 1

Key:—1. Sirius Satellite Communications System—2. Railroad Satellite Communications Center No 1—3. Division Satellite Communications Center—4. Central Satellite Communications Center—5. Railroad Satellite Communications Center No *n*—6. Interaction zone—7. Ministry of Railways' existing Railroad Communications Center No 1—8. Ministry of Railways' existing Division Communications Center—9. Ministry of Railways' Central Communications Station—10. Ministry of Railways' existing Railroad Communications Center No *n*—11. Ministry of Railways' operating communications system—12. Consolidated diagram of interaction between the Sirius Satellite Communications System and the Ministry of Railways' operating communications system—13. Data interaction—14. Interaction of control systems—15. Interaction with network established connections—16. Users

2. The System's Structure

The structure of the Ministry of Railways' Sirius SCS in its fully deployed state includes:

2.1. **The Space-based Segment.** It is based on two space vehicles (KA) of an orbiting group of existing Gorizont space vehicles arranged in a geosynchronous orbit (GSO) with points of sight of 80° or 90° East Longitude and 96.5° East Longitude and equipped with a set of relay equipment.

After the end of the use of the Gorizont space vehicles and their replacement by the Ekspress space vehicles with the same points of sight in geosynchronous orbit, the system can shift to the use of the broadband channels of their repeaters.

2.2. **The Ground-based Segment.** Its structure includes:

—a Central Satellite Communications Center (TsUSS) consisting of a Central (coordinating) Ground Station with a capacity of no fewer than 372 channels and a System Control Center (TsUS) equipped with the hardware and software of an automated satellite communications control system (ASUSS).

—31 Railroad Satellite Communications centers (DUSS). Each one has been furnished with Branching (railroad) Ground stations (UZS) with a capacity of up to 60 channels. They have been located at the railroad divisions in the cities of Khabarovsk, Tynda, Chita, Irkutsk, Kemerovo, Novosibirsk, Yekaterinburg, Chelyabinsk, Krasnoyarsk, Alma-Ata, Tashkent, Tselinograd, Aktyubinsk, Minsk, Nizhniy Novgorod,

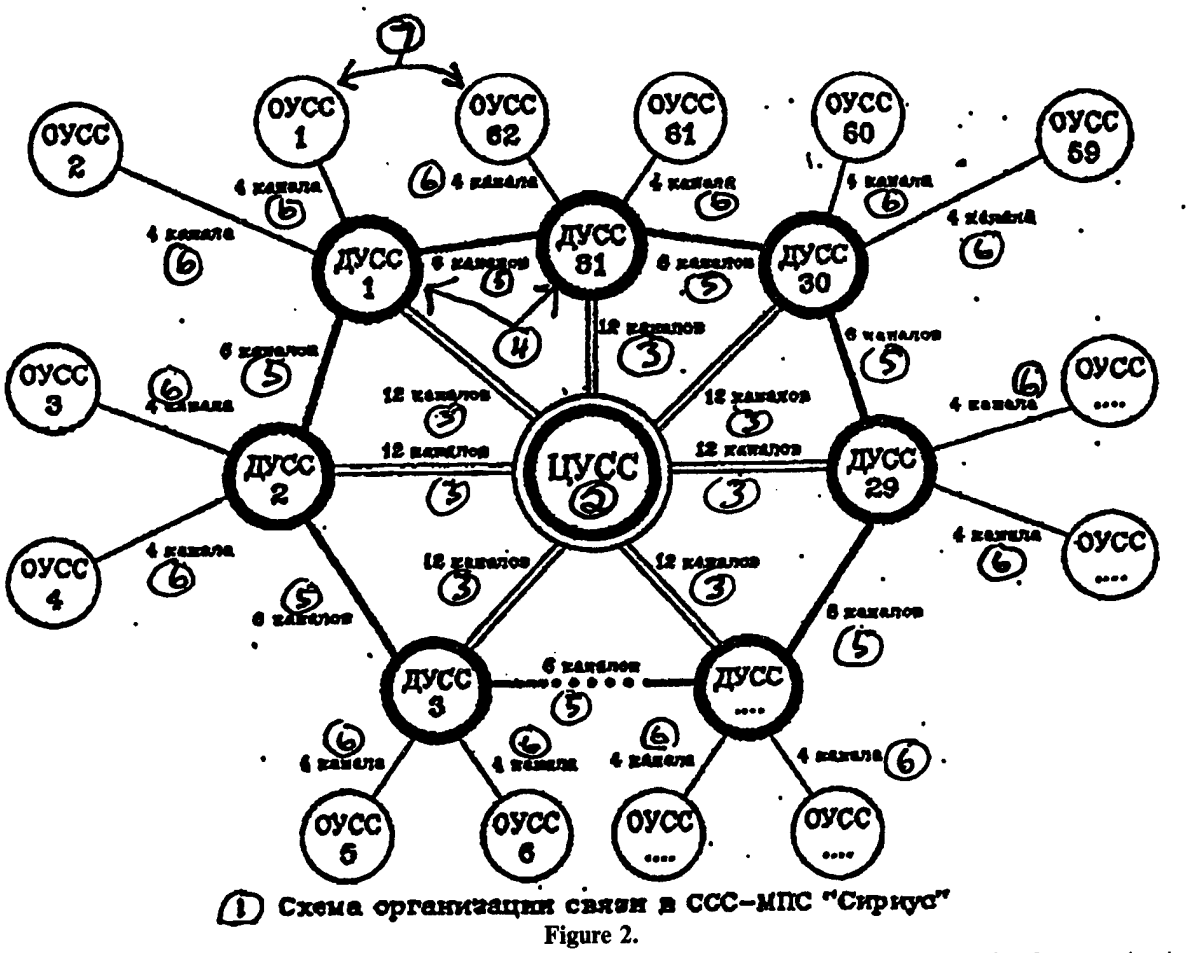


Figure 2.

Key:—1. Diagram of organization of communications in the Ministry of Railways' Sirius Satellite Communications System—2. TsUSS—Central Satellite Communications Center—3. 12 channels—4. DUSS—Railroad Satellite Communications centers Nos 1-31—5. 6 channels—6. 4 channels—7. OUSS—Division Satellite Communications centers Nos 1-62

Donetsk, Tbilisi, Baku, Samara, Lvov, Kishinev, St. Petersburg, Odessa, Riga, Saratov, Dnepropetrovsk, Yaroslavl, Rostov, Kiev, Voronezh, and Kharkov.

—62 Division Satellite Communications centers (OUSS), furnished with Terminal (division) Ground stations (OZS) with a capacity of no fewer than 5 channels and located at railroad divisions more than 300 km distant from the railroads' administrations.

The diagram of the organization of communications in the Ministry of Railways' Sirius SCS is depicted in figure 2.

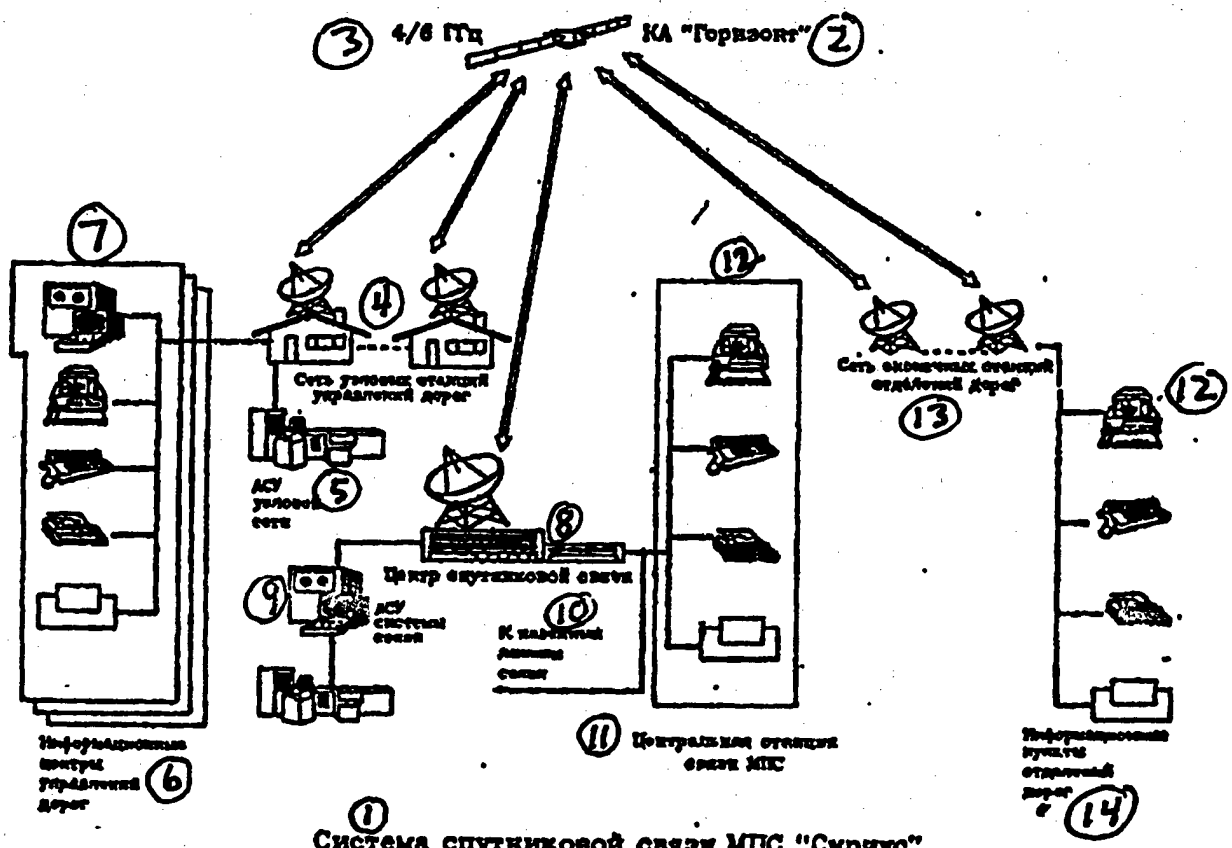
The System's Basic Characteristics

3.1. The Ministry of Railways' Sirius SCS forms a primary network of digital satellite communications channels which are used as the basis for the construction of secondary networks for long-distance telephone, telegraph, telex and facsimile [fax] communications, as well as of a network for data communications of an intercomputer exchange nature, including information computer networks.

The Ministry of Railways' Sirius SCS is depicted in figure 3.

3.2. Communication within the system is organized according to the radial and radial-branching principles, as well as, with the full-scale deployment of the system, according to the principle of "each one-to-each other" at the levels of the railroad and division stations. The servicing of users within the system is accomplished on a request basis.

3.3. The system's area of coverage is the territory of the Russian Federation and of the republics which are part of the Commonwealth of Independent States, as well as the Baltic States (Latvia, Lithuania and Estonia) and the Transcaucasus (Georgia).



Система спутниковой связи МПС "Сириус"

Figure 3.

Key:—1. The Ministry of Railways' Sirius Satellite Communications System—2. Gorizont space vehicle—3. 4-6 GHz—4. Railroad administrations' branching station network—5. Branching network's ASU [automated control system]—6. Railroad administrations' information centers—7. Symbols in descending order: mainframe computer; personal computer; telephone; telegraph; facsimile—8. Satellite Communications Center—9. Communications system's ASU—10. To cable communications lines—11. Ministry of Railways' Central Communications Station—12. Symbols in descending order: personal computer; telephone; telegraph; facsimile—13. Railroad divisions' terminal station network—14. Railroad divisions' information centers

3.4. The band of operating frequencies is 4-6 GHz [Gigahertz].

3.5. The method for the multistation access of ground stations to the satellite's repeater is by frequency division multiplexing using the single channel-carrier version (MDChR-OKN), as well as by time division multiplexing of the channels of composite signals (MDChR-VRK).

3.6. The method for transmission of information in the system's communications channels is digital and the error probability in a channel is no greater than 10^{-6}.

3.7. The system's carrying capacity during the use of the communications resources of a single broadband channel of a Gorizont space vehicle amounts to:

—372 channels in the radial network;

—up to 54 channels in each of the 31 branching communications networks.

3.8. A single broadband channel of a Gorizont space vehicle is used to provide communication between:

—the satellite communications center and the 31 branching (railroad) stations;

—each of the 31 branching (railroad) stations with 2-3 neighboring branching (railroad) stations;

—each of the 31 branching (railroad) stations with 3-5 terminal (division) stations.

3.9. The information transmission rate in a basic digital channel is 16 kbit/s and, in the composite channels, it is 256, 2048 and 4096 kbit/s. In a single 16 kbit/s channel, there is the possibility of simultaneous time division

multiplexed transmission of several types of information in various combinations of subchannels:

—telephony with a rate of 9.6 or 16 kbit/s;

—data communications with rates of up to 9.6 kbits/s;

—fax communications with a rate of 4.8 kbit/s;

—telex (telegraph) communications with a rate of 0.2 kbit/s.

Ground stations can be connected with the digital channels of the secondary network. The digital channels' rate should be 64, 256 or 4096 kbit/s.

3.10. The transmission quality of voice communications meets the requirements of GOST [state standard] V 20.775-76, while the intelligibility satisfies the second class of quality with a 95-percent probability.

3.11. The system's channels, organized for data communications and intercomputer exchange, are used in information networks of any configuration. They are constructed on series-produced domestic computers, as well as on the more widespread foreign computers.

3.12. Provided in the system is the encoding of information transmitted over the communications channels using hardware and software.

3.13. Connecting the Sirius system's channels with the Ministry of Railways existing communications networks and the YeASS [National Unified Automated Communications System] has been provided for.

3.14. Provision has been made for the possibility in the future of expansion of the Sirius SCS to the railroad departments of the contiguous foreign countries of Europe and Asia.

3.15. The automated control system organizes the operation of the system. It uses the service channels in the general streams of information transmitted over the satellite channels.

3.16. The cost of communications services rendered by the Ministry of Railways' Sirius SCS is not higher than that of existing systems in the Russian Federation.

4. The Organization of the Satellite Communications Networks

4.1. The Sirius SCS is organized based on a network of satellite communications channels in the 4-6 GHz band, which are formed by the ground stations and the Gorizont space vehicles' repeaters (in the future, Ekspress-type space vehicles).

4.2. The following measures for enhancing efficiency are used in the satellite communications system:

—the combining of individual channels for the transmission of various types of communications into a common beam ("composite stream") formed at the ground stations;

—the organization of composite streams of varying capacity;

—the simultaneous use of composite streams assigned and unassigned by frequency;

—the use of unidirectional and multidirectional simplex composite streams in various combinations for the organization of duplex communications channels;

—the implementation of an unassigned channel mode within a common fully accessible composite stream;

—the use of the statistics of voice signal intervals.

4.3. The information streams transmitted over Sirius SCS composite channels are multiplexed. Three types of composite streams of varying channel capacity are used:

—low-speed—16 kbit/s;

—medium-speed—256 kbit/s;

—high-speed—2048 (4096) kbit/s.

4.4. The organization of communications in the Sirius SCS is built on the hierarchical radial-branching principle, where three types of satellite communications networks are established:

—a radial network for Ministry of Railways Central Satellite Communications Center communications with the Railroad Satellite Communications centers;

—an intercenter network for communications between the Railroad Satellite Communications centers of adjacent railroads;

—and branching networks for Railroad Satellite Communications Center communications with their subordinate Division Satellite Communications centers.

The structural diagram of the organization of the communications is given in figure 4.

4.5. Constructed at the first level of the hierarchy is the radial network which provide communications between the Central Satellite Communications Center and the railroad administrations' communication centers. This network's connecting link is the Central Satellite Communications Ground Station (TsZS) which is located at the Central Satellite Communications Center (TsUSS).

Organized at the railroad administrations' communications centers are Railroad Satellite Communications centers (DUSS), where the branching stations (UZS) are located, which are peripheral for a network of this level.

Transmitted via a single satellite repeater in the examined radial network are:

—two high-speed composite streams with rates of 4096 and 2048 kbit/s, which make up respectively 256 and 128 simplex communications channels going from the Central Satellite Communications Center to the Railroad Satellite Communications centers;

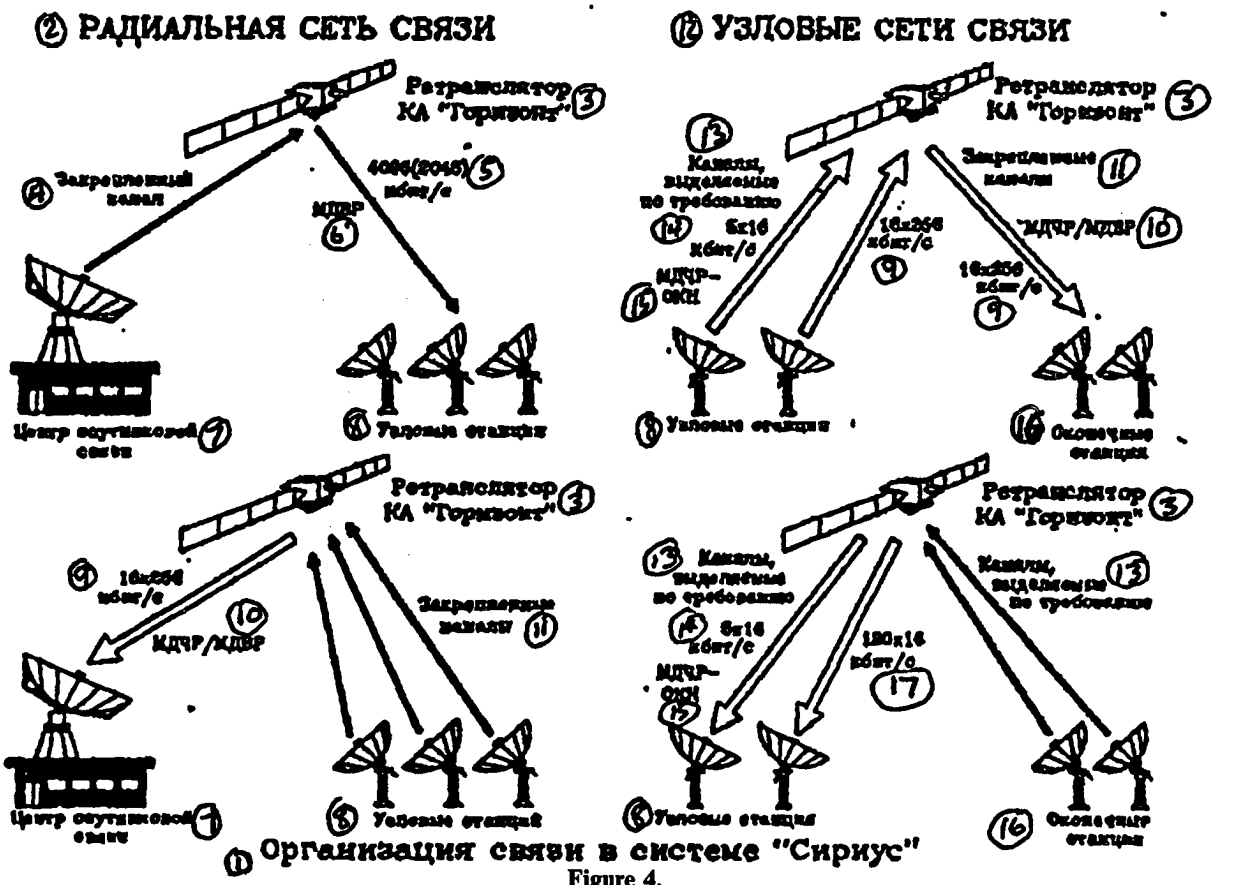


Figure 4.

Key:—1. The organization of communications in the Sirius system—2. Radial communications network—3. Gorizont space vehicle's repeater—4. Assigned channel—5. 4096 (2048) kbit/s—6. Time division multiplexing—7. Satellite communications center—8. Branching stations—9. 16 x 256 kbit/s—10. Frequency division multiplexing/time division multiplexing—11. Assigned channels—12. Branching communications network—13. Channels allocated on request—14. 5 x 16 kbit/s—15. Single channel carrier frequency division multiplexing—16. Terminal stations—17. 120 x 16 kbit/s

—31 medium-speed streams with a rate of 256 kbit/s, which make up 16 simplex channels going from each Railroad Satellite Communications Center to the Central Satellite Communications Center.

Used in the radial network is the assignment of channels to communications links with the possibility of non-real-time switching.

The first-level radial network, when the system is fully deployed, is supposed to include 31 medium-speed streams of 12 channels each in each direction during the busiest hours.

Used in this network are multistation access with frequency division multiplexing of the channels and the transmission on each carrier of a composite signal with time division multiplexing (a high- or medium-speed composite stream)—MDChR-VRK.

4.6. On the second level of the hierarchy, communication is organized between the railroad administrations' Railroad Satellite Communications centers. They are joined into group networks of two to six adjacent Railroad Satellite Communications centers. In each group, in order to provide information exchange, medium-speed streams with a rate of 256 kbit/s are used.

On this level of the hierarchy, just like on on the first, use is made of the frequency division multiplexing plus carrier time division multiplexing method of multistation access and the assignment of channels to communications links.

4.7. On the third level of the hierarchy, networks are organized, which are constructed according to the branching principle. They provide communication between the Railroad Satellite Communication centers and the subordinate communication centers of the railroads' divisions. The center's role in each network is performed by the Railroad Satellite Communications Center. The peripheral stations in these networks are the terminal satellite communications stations with few channels, which are located at the communications centers of the railroads' divisions.

The third-level network includes 32 networks for railroad communications and data communications. Each network will include:

—a branching station at the railroad's Administration Communications Center;

—four to six peripheral Railroad Division Satellite Communications stations.

In each of the branching networks, information exchange going from the center to the periphery is accomplished using a medium-speed information stream with a rate of 256 kbit/s and the multistation access method of frequency division multiplexing with carrier time division multiplexing. In the opposite direction, communication is accomplished using low-speed information streams with a rate of 16 kbit/s and, for multistation access, the frequency division multiplexing method in the single channel carrier version (MDChR-OKN) is used, with channels being allotted on request.

With the organization of multistation access in the frequency division multiplexing with a single channel carrier mode, when a low-speed stream is transmitted on a separate carrier, an opportunity is provided for turning off the ground station's transmitter during voice signal intervals.

In each of the branching networks, the transmission of a single stream with a rate of 256 kbit/s and of up to 16 streams with a rate of 16 kbit/s is provided.

4.8. The operation of the communications networks is carried out in an asynchronous mode. The Central Ground Station and the railroad (branching) stations operate during communication with one another over assigned channels on fixed frequency positions, on which the above-indicated high-speed and medium-speed composite streams are transmitted.

Channel allocation for communication with terminal stations is accomplished by the Satellite Communications Center on request in the single channel carrier (OKN) mode. At this time, one of the frequency positions in the repeater's broadband channel, which is available at this moment, is assigned to the calling station. The load for a single frequency channels amounts to not more than 7-10 calling stations.

From one to three frequency positions in the network are allotted for the organization of a general signaling channel for querying terminal stations about assigning them a channel on request (during the implementation of this mode).

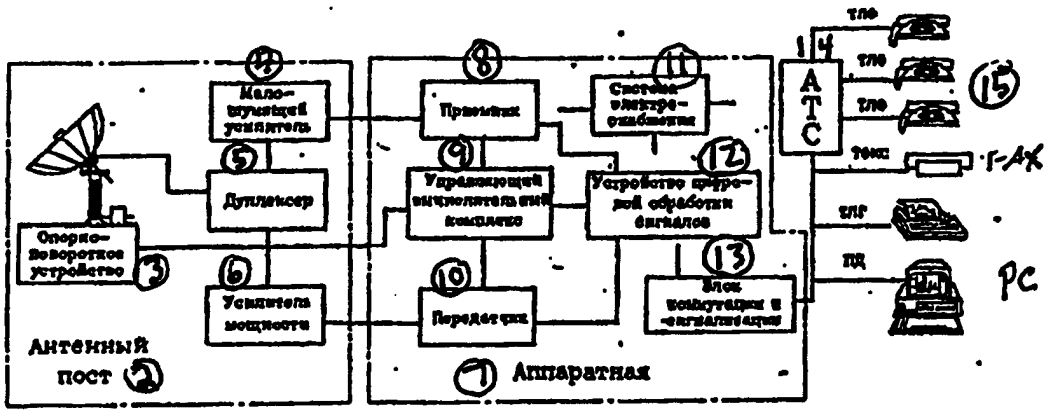
The establishment of connections in the single channel carrier mode occurs by issuing a request over an OKS [single communication channel] to the Central Satellite Communications Center. Here an analysis is made of the available frequency positions of callers over the single communication channel. After their transceivers are set to these positions, a communications session is carried out between them via the Gorizont space vehicle's repeater without further Central Satellite Communications Center participation.

5. The Branching Ground Satellite Communications Station for Railroad Administrations

The Branching Ground Station is intended for the organization of satellite communications in radial and branching communications networks with assigned channels and servicing of users on request.

It is located at the Satellite Communications centers of the railroads' administrations. The Branching Ground Station is connected with the existing communications centers and information computer centers of the railroads' administrations by land lines.

The structural diagram of a Sirius branching station for a railroad administration is given in figure 5.



① Структурная схема станции спутниковой связи

Figure 5.

Key:—1. Structural diagram of a satellite communications station—2. Antenna station—3. Support and steering equipment—4. Low-noise amplifier—5. Duplexer—6. Power amplifier—7. Control room—8. Receiver—9. Controlling computer system—10. Transmitter—11. Power supply system—12. Signal digital processing equipment—13. Switching and signaling unit—14. ATS [Automatic Telephone Exchange]—15. Symbols from top to bottom: 3 telephones; fax; telegraph; personal computer

The branching station consists of a unified antenna station, a transceiving system, channel-forming equipment, equipment for connecting with ground networks, Automatic Control System equipment and power supply equipment.

Basic Technical Characteristics

Frequency band	Reception—3650—4150 Mhz
	Transmission—5975—6475 MHz
Antenna	Parabolic mirror 5 m in diameter
Reception quality factor	Greater than 22 dB/K
EIIM	Greater than 66 dBW
Transmitter power	1 kW
Channel capacity	Up to 60 digital channels at 16 kbit/s
Type of transmittable information	Telephone, telegraph, fax, personal computer
Multistation access method	Frequency division multiplexing with single channel carrier, frequency division multiplexing with carrier time division multiplexing
Placement	In heated premises or in two prefabricated buildings (1 control room, 1 antenna)
Weight	Less than 3,000 kg
Servicing	1 operator (per shift)
Operating Conditions	Round-the-clock
Power Supply	Alternating current with a voltage of 380/220 V (+10 to -15) percent with a frequency of 50 Hz plus or minus 2
Required power	Less than 10 kW per A
Range of operating temperatures for equipment located outside a building	-50° to +50°C

The branching station simultaneously provides the organization of:

—a single communications link with a capacity of up to 12 channels with Central Satellite Communications Center and which operates using frequency division multiplexing with carrier time division multiplexing;

—up to three communications links with a capacity of up to six channels each with the Railroad Satellite Communications centers, which operate using frequency division multiplexing with carrier time division multiplexing;

—up to five communications links with a capacity of up to six channels each with the terminal stations.

In order to provide the indicated capabilities, a branching station simultaneously provides:

—reception of the composite signal of a time division multiplexed carrier with a rate of 4096 (2048) kbit/s from the Central Satellite Communications Center and the formation from this signal of up to 12 digital channels;

—reception of up to four composite signals of a time division multiplexed carrier with a rate of 256 kbit/s from the Railroad Satellite Communications centers and the formation from each of these signals of four to six digital channels;

—reception of up to 24 channels of frequency division multiplexing with a single channel carrier with a rate of 16 kbit/s from the railroads' Division Communications centers;

—reception on a fixed frequency of a test signal for automatic frequency control;

—transmission of up to 3 composite signals of a time division multiplexed carrier with a rate of 256 kbit/s to the Central Satellite Communications Center and to the Railroad Satellite Communications centers with the insertion into each of these signals of up to 16 digital channels;

—transmission of up to eight digital channels, assigned on request, to the terminal stations of a branching network;

—that each of the basic digital channels with a rate of 16 kbit/s may be multiplexed in varying combinations.

The station's interfaces provide a means for connecting it with the data communications equipment and the possibility of connecting to end terminals and departmental Automatic Telephone exchanges.

The station operates in an automated mode. Access control and changing the station's operating conditions are done remotely from the Satellite Communications Center over the service channel.

The station's modular construction makes it possible to increase the channel capacity by six-channel groups.

6. The Terminal Ground Satellite Communications Station for Railroad Divisions

The terminal ground station is intended for the organization of satellite communications in branching communications networks and of the servicing of users on request.

It is located at the Railroad Division Communications centers and is connected with the existing Railroad Division Communications centers by land lines.

The terminal station consists of the same centers as the Railroad Administration Ground Station (see figure 5) and differs basically in the transmitter's power.

Basic Technical Characteristics	
Frequency band	Reception—3650—4150 Mhz
	Transmission—5975—6475 MHz
Antenna	Parabolic mirror 5 m in diameter
Reception quality factor	Greater than 22 dB/K
EIIM	Greater than 58 dBW
Transmitter power	100 W
Channel capacity	No fewer than five digital channels at 16 kbit/s
Type of transmittable information	Telephone, telegraph, fax, personal computer
Multistation access method	Frequency division multiplexing with single channel carrier, frequency division multiplexing with carrier time division multiplexing
Placement	In heated premises or in two prefabricated buildings (1 control room, 1 antenna)
Weight	2,800 kg
Servicing	1 operator (per shift)
Operating Conditions	Round-the-clock
Power Supply	Alternating current with a voltage of 380/220 V (+10 to -15) percent with a frequency of 52 Hz plus or minus 2
Required power	Less than 3 kW per A
Range of operating temperatures for equipment located outside a building	-50° to +50°C

The terminal station simultaneously provides the organization of a single communications link with a capacity of up to six channels with the Railroad Satellite Communications Center using frequency division multiplexing with a single channel carrier.

In order to provide the indicated capabilities, the terminal station simultaneously implements:

—reception of a single composite signal of a time division multiplexed carrier with a rate of 256 kbit/s from its own Railroad Satellite Communications center and the formation from it of up to six digital channels;

—reception of up to six digital channels of frequency division multiplexing with a single channel carrier with a rate of 16 kbit/s from the Railroad Satellite Communications Center;

—transmission of up to six digital channels of frequency division multiplexing with a single channel carrier with a rate of 16 kbit/s, assigned on request, to its Railroad Satellite Communications Center;

—that each of the basic digital channels with a rate of 16 kbit/s may be multiplexed in varying combinations:

a telephone channel with a rate of 9.6 or 16 kbit/s;

a data communications channel with a rate of up to 9.6 kbit/s;

a fax communications channel with a rate of up to 4.8 kbit/s;

a telex (telegraph) communications channel with a rate of up to 0.2 kbit/s.

The station's interfaces provide a means for connecting it with the data communications equipment and the possibility of connecting to end terminals and departmental Automatic Telephone exchanges.

The station operates in an automated mode. Access control and changing the station's operating conditions are done remotely from the Satellite Communications Center over the service channel.

7. The Automated Control System

The automated control system of the Sirius SCS under discussion is built according to the hierarchical principle and includes three levels:

—control in the radial-branching network, implemented by the central control system at the Satellite Communications Center;

—control in the branching networks, implemented by the unified control systems at the Railroad Satellite Communications centers;

—control of the operation of the ground stations' equipment.

The Communications Control Center's Central Control System implements interaction with the Central Satellite Communications Center, the Ministry of Railways' Central Communications Station and the state communications network of the National Unified Automated Communications System and organizes the system's operation to the level of the branching stations and, when need be, of the terminal stations.

The Unified Control System of the Railroad Satellite Communications Center implements interaction with the Communications Control Center and the information centers of the railroad administrations and organizes (plans) the operation of the satellite branching network, coordinating it with the Communications Control Center's plan.

The software of the control system makes it possible to solve the following basic problems:

—automation of the process of organizing communications channels between users;

—planning and rapid re-assignment of the system's communication resource (carrying capacity);

—real-time monitoring of the parameters of the system and the ground satellite communications stations;

—the collection and processing of statistical information on the quality of the functioning of the satellite communications system and its components, on the

time of use of the channels by users, rate setting and the conducting of financial settlements with the users.

The lowest control organ is the terminal station's control module. It controls its operating conditions.

The Automated Control System uses the service channels. They are transmitted in the common information streams over the satellite channels.

8. The Economic Efficiency of the Sirius SCS

The economic efficiency of the Ministry of Railways' Satellite Communications System is determined by three factors:

—improvement of control of the shipping process through more intensive, more accessible and qualitatively better information exchange;

—a decrease in expenses through the lower operating expenditures for the Ministry of Railways' Sirius SCS in comparison with the leasing of channels in the Ministry of Communications;

—the derivation of additional revenues from the opportunities for the managing entities to rent out unused communications channels for commercial use at contract rates.

In addition to increasing the efficiency of the transport shipments of national economic freight and passengers, the system makes it possible:

—to ensure the widespread satisfaction of the social needs for communication services of railroad transport workers living in remote and nearly inaccessible regions in the railroads' areas;

—to facilitate and to accelerate the integration of the Ministry of Railways' communications network into the unified, with commercial structures, transport and information network of the European and Asiatic countries for the paperwork-free shipping of freight on international and transit railways.

The end users' expenditures for the development and operation of the part of the Sirius SCS related to them are several time lower than the average annual cost of leasing TCh [voice frequency] communications channels from the Ministry of Communications, where a single channel costs around 500,000-600,000 rubles [R] per year.

The solution of the problems involving the additional organization of 1,300 high-quality communications channels for the railroads' networks (as provided for by the technical specifications for the development of the Sirius system) by traditional methods through the laying of balanced cables and the multiplexing of their K-60 analog transmission system, given the existing prices for materials and equipment, exceeds somewhat the overall expenditures for the development of the system.

9. The Organization of the Work on the Development of the System

In order to organize the work on the development and deployment of the Ministry of Railways' Sirius SCS, a proposal has been made for the establishment of a joint-stock railroad telecommunications company, Transintelcom. Its founders might include:

—the Ministry of Railways' Signals, Communications and Computer Technology Administration;

—the Ministry of Railways' Central Communications Station;

—the Russian Federation Ministry of Communications' Space Communications Department;

—the basic developers of the system's equipment;

—the railroads' administrations;

—the Zheldorbank [railroad bank] and other enterprises and organizations.

The basic users of Transintelcom's services would be the administrations of railroads interested in improvement of the quality of information and telecommunications support of the shipping process.

The Transintelcom Joint-Stock Company would be the holder of the entire communications resource of the satellite communications system (it would lease the satellite's repeaters) and the owner of the Central Satellite Communications Center. It would assign communications channels to the railroads' regional administrations on a long-term leasing basis for the organization of information exchange between the users within the regions serviced by them or on request on pay-as-used terms in order to provide communications between regions or with the Ministry of Railways and would also rent out the communications channels for commercial use.

For the further improvement of the organization of the deployment of the Sirius system and its subsequent use, a proposal has been made to establish, along with the Transintelcom Joint-Stock Company, regional joint-stock railroad information and telecommunications companies based on the railroad administrations' signals and communications services.

The founders of the regional joint-stock railroad information and telecommunications companies might be:

—the railroads' administrations;

—the Transintelcom Joint-Stock Company;

—local state communications and information science enterprises;

—local commercial banks;

—interested institutions and organizations.

Each of the regional joint-stock railroad information and telecommunications companies would specialize in the rendering of communications services to users associated with supporting the shipping process in the region serviced by a specific railroad and would be independent of one another in financial matters. It would carry out its task of rendering information services to users in its own region based on the principles of total cost recovery and ensuring the necessary standard of profit for its own shareholders.

When it begins functioning, the satellite communications system may possibly be used not only to provide communications for the shipping process, but also, on a commercial basis, to offer services in the following areas:

—providing information and computer services (reference information from data banks, analytical calculations, modeling, forecasting and so on), using the railroads' computer centers, to users located within the area of activities of each regional company;

—offering users of a given region the opportunity to access the information and computer resources of other regions and the resources of the Ministry of Railways' Main Computer Center and its information;

—and offering the services of the Sirius communications system not just to participants in the shipping process, but also to any other users of a given region.

In order to set up the Sirius SCS, ground stations are being acquired by each railroad using its own assets. The estimated cost, based on prices for March, 1992, is:

—R5.0 million for a branching (railroad) station;

—R3.5 million for a terminal (division) station;

—R70,000-140,000 for the annual cost of leasing a single channel of the satellite communications system.

In addition to this, the one-time expenditures of a railroad for setting up the Sirius system include: the development of the detailed design, installation and adjustment and placement into service of the system. At the same time, each railroad, prior to the delivery of the equipment, is supposed to prepare a site for housing it. All the listed operations (except the preparation of the sites for the branching and terminal stations) can be performed by the company in a centralized fashion based on contracts with the railroads.

10. Time Frames for Placing the System into Service

Planned for the current year is the completion of the stage of drafting of the design documents and the manufacture of 10 pilot models of the ground satellite communications stations for a test region.

The placement into service of the test region (the zones of the Siberian railroads and the first phase of the Central Satellite Communications Center in the area of the city of Moscow) will be implemented in the first half of 1993.

Full-scale deployment of the system is planned for completion in 1995-1996.

11. The Buyer and the Developer

The buyer for the Ministry of Railways' Sirius SCS is the Russian Federation Ministry of Railways' Signals, Communications and Computer Technology Administration.

The developer of the Ministry of Railways' Sirius SCS is the Moscow Astra Scientific Production Association which incorporates the organizations of the developers and the manufacturers of the Sirius system's hardware and software.

Application of CMOS Microcircuits

937K0143A Moscow RADIO in Russian
No 1, Jan 93 p 31

[Article by S. Alekseyev]

[Abstract] A table is provided listing Complimentary metal-oxide-semiconductor structures which were discussed previously in this journal. The table includes their functional designation, as well as the year, number and the first page of their description in the journal "Radio". In brackets, after the functional designation of some microcircuits, the first digit indicates the number of information inputs, the second digit indicates the number of outputs, the letter Z indicates the feasibility of switching the inputs into a high impedance state, the letters OS indicate the availability of an output with the open drain.

Use of Renewable Energy Sources in Municipal Heat Supply Systems

937K0150A Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 93 pp 27-29

[Article by V.G. Nekrasov, candidate of technical sciences, All-Russian Scientific Research and Planning Institute of Power Generation Industry; UDC 621.186:620.97]

[Abstract] Utilization of renewable energy sources has become a worldwide trend associated with growing concern about protection of the environment and with ecological requirements including conservation. Unconventional renewable energy sources such as solid waste now constitute about 3-5 percent and only rarely 10-12 percent of all energy sources utilized worldwide, though in individual regions their fraction may reach 25 percent (California, U.S.A.) and even 80 percent (Szechwan province in mainland China). Their use is particularly widespread, primarily for heating, in regions not served by large central energy supply systems. An important consideration is to ensure lower levels of CO_2 and other pollutant emission, realizable by methane fermentation of solid waste. One kind of such a solid waste is household garbage. Utilization of 5×10^6 m^3 garbage as fuel source for the Tashkent municipal heat supply system saves over 10,000 tons of conventional solid fuel at a cost of less than 100 rubles per ton. Agricultural byproducts are another kind of solid waste useful as energy source. Compost is not being considered, because it does sufficiently ripen for reprocessing and may contain toxic substances present in the food production chain. An excellent energy source are plants rich in starch and sugar, their cultivation on specially designated land for subsequent reprocessing has in many countries yielded substantial amounts of clean solid fuel and liquid fuel (alcohol: methanol or ethanol), while methane fermentation of perennial plants may very well yield substantial amounts of clean gaseous fuel. Operation of such energy gardens for the Almaty municipal heat supply system has had to include intense irrigation as a way to stabilize or lower the water level. Ions of heavy metals are not objectionable here when solid waste is used as fertilizer, inasmuch as they then circulate in the fuel loop without entering the food loop. On the basis of a 50 kcal/h power yield as tentative basis of reference, production of such a fuel requires a garden area of 400 ha and 4×10^6 m^3 water annually for irrigation. Other promising energy sources for municipal heating plants are discarded worn automobile tires (in the U.S.A., England, Italy, Russia, possibly in Kazakhstan), if properly burned, and wood. Wood, a lower-grade solid fuel, can be and in some countries (Finland, England) is being converted by pyrolysis into a higher-grade gaseous fuel suitable for generating steam in boilers of small 25 kW electric heating power plants.

Possibilities and Prospects of Transmitting 1500 kV DC Power Over Ekibastus-Tambov Line

937K0150B Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 93 pp 33-39

[Article by V.A. Barinov, doctor of technical sciences, and A.S. Manevich, engineer, Institute of Power Engineering imeni G.M. Krzhizhanovskiy; UDC 621.3.051.024.027.89]

[Abstract] Construction of the Ekibastuz-Tambov 1500 kV DC transmission line was being planned during the nineteen sixties and seventies for the purpose of transferring excess electric energy from Kazakhstan into the European part of the former USSR, with the Ekibastuz power system in Kazakhstan to be consisting of 4-5 fuel-operated state regional electric power plants with a total capacity of 16,000-20,000 MW. The DC transmission line was designed to carry power covering a base load of 6000 MW for up to 7000 hours a year, only one 4000 MW plant having so far been built. Construction of the DC transmission lines was also justified by the development of nuclear power in the European regions and the necessity of utilizing Siberian hydroelectric power for coverage of peak loads in the European regions, but subsequent cutback of nuclear power development diminished the need for DC power transmission. Now the need for it is being justified by the heavy demand for and increasingly insufficient supply of electric energy in the European part of Russia, with excess electric power still being available in Eastern Siberia. This justification is tentative, however, considering that: 1) addition of 1500-2000 MW will not substantially improve the energy balance in the European regions of Russia, inasmuch as it would amount to an only 2 percent increase of available power; 2) some electric energy is for a long time being transferred and most likely will continue to be transferred from western to eastern regions; 3) the Central integrated power grid, into which the DC power is to be fed, actually does not now underproduce but rather overproduces electric energy; 4) the Siberian integrated power grid does produce excess peak power, but the amount of electric energy available for transfer elsewhere depends on the status of water in the storage basins and thus is a random quantity; 5) in accordance with the energy development program planned for Russia, all regions are to become self-sufficient by the year 2000. The possibility of feeding more electric energy from power plants in Eastern Siberia to the Urals and European Russia is analyzed in technical and economic terms, considering transmission over 1150 kV AC overhead lines with or without participation of the Ekibastuz-Tambov 1500 DC transmission line so as to determine the role that line may play in the overall planning. While construction of 1150 kV AC overhead lines is to proceed in three stages, four schemes are being compared: 1) completing construction of the Ekibastuz-Tambov DC transmission line within the first stage, 2) completing construction of its Ekibastuz-Urals segment only and erection of a converter substation in the Urals, 3) terminating further construction of the DC transmission line and either retaining or dismantling it, 4) using the DC transmission line as a two-phase or incomplete three-phase AC transmission line from Ekibastuz to either Tambov or to the Urals only. Completing construction of the DC transmission line is shown to require as many material and financial resources as constructing 5000 km of 500 kV AC transmission lines for Russia and Kazakhstan. The role of this DC transmission line is thus still tentative, the second scheme including a 3000 MW converter substation in the Urals nevertheless appearing to be so far the best one. Tables 6.

Development of Methods To Calculate Electric Loads

937K0146A Moscow ELEKTRICHESTVO in Russian No 2, Feb 93 (manuscript received 14 Jan 92) pp 1-9

[Article by I. V. Zhezhelenko, V. P. Stepanov]

[Abstract] It has been found that traditional load calculation methods lead to significant errors. Only two load characteristics can be found: the average load and the heating load. Improvements can be achieved by switching from the traditional statistical modeling method to a dynamic modeling method, which provides a more informative mathematical model of this random process. Three dynamic modeling methods have been developed theoretically: probabilistic modeling, the inertial method, and the hierarchically structured method. Features and equations associated with each of the three methods are presented. Problems hindering the practical implementation of mathematical models are addresssed, for example, the need to develop a new information base of initial data, and the equipment needed to measure individual characteristics of the electric load. A schematic of an experimental load measuring device is presented and explained. Figures 3; tables 3; references 18 (Russian).

Eliminating Overloads in an Electrical Power System by Changing Grid Configuration

937K0146B Moscow ELEKTRICHESTVO in Russian No 2, Feb 93 (manuscript received 20 Apr 92) pp 9-18

[Article by M. A. Khozyainov, Moscow Energy Institute]

[Abstract] Elimination of overloads in power systems after an accident or failure is of great importance in complex power systems. One way of eliminating overloads is multiple switching of lines, transformers, and section circuit breakers. However, one must determine a near-optimal switching sequence in a limited period of time, which is a great challenge. The problem consists of a number of subproblems, each fraught with its own difficulties: decomposition of the grid into switching elements; initial sorting of candidates for switching by an atypical mode criterion; calculation of the steady-state mode; and calculation of short circuit currents. This article presents a new unified approach to this problem using a matrix of node conductivities/resistances. An example of its development and use is given. An algorithm to determine the steady-state mode is presented. Obstacles to the use of the node resistances method is described. The method exhibits stable convergence and has been field tested. It is shown that suitable, if approximate, solutions are obtained in the first few iterations, which is important in time-critical situations. Tales 8; references 9: 4 Russian, 5 Western.

Effect of Nonequipotentiality of Extended DC Grounds on Their Electric Characteristics

937K0146C Moscow ELEKTRICHESTVO in Russian No 2, Feb 93 pp 34-38

[Article by G. S. Kazarov, G. N. Portnoy, St. Petersburg]

[Abstract] A key feature of DC transmission grounding devices is that the surface of the electrodes extends over a large area. The electrodes carry either the total transmission current (unipolar mode) or the unbalance current (bipolar mode). Hence, one must use extremely long grounding devices. The longitudinal resistance of circuits of this size is comparable with their current-propagation earth resistance (assuming equipotentiality of the circuit). As a result of a drop in voltage along the grounding circuit there is a redistribution of current on the surface of the grounding device, which leads to additional power losses, consumption of the electrode, and a drastic local increase in field strength in the earth. Thus, one of the main optimization problems in the design of grounding devices is providing the required distribution of potential in the grounding circuit. This can be achieved by selecting the appropriate design of the grounding device and by using appropriate connection of the circuit to the extension and alternate aerial lines. These calculations are presented in the article. Several examples are presented, including the example of a nonequipotential ground in a two-layer medium with a horizontal interface. Analysis of the results of calculations presented in the article shows that the specific resistance of earth adjacent to the circuit has the greatest effect on nonequipotentiality of the grounding circuit. As the specific resistance of the earth increases, the effect of nonequipotentiality decreases. Thus, it is very important to consider the nonequipotentiality of a ground in a medium with a low specific resistance. The presence of several down conductors reduces nonequipotentiality. Figures 5.

The Skin Effect in Parallel Wires. Parameters, Losses, and Electrodynamic Forces

937K0146D Moscow ELEKTRICHESTVO in Russian No 2, Feb 93 (manuscript received 5 Aug 92) pp 60-67

[Article by E. V. Kolesnikov, Volgograd Polytechnical Institute]

[Abstract] This article continues the discussion of a previous article by the author in this journal (ELEKTRICHESTVO Jan 93) where the current density of parallel wires with a circular cross section is determined. The Joule losses of the current-carrying system are described. Three conclusions are reached. 1) Calculation of the N+1 basic mode of the current-carrying system using the energy balance method makes it possible to obtain an equation for the system as an active 2N-pole system. 2) Heat losses in wires are expressed by a formula which separates DC losses, the skin effect, and the effect of closeness of other wires and an external field. 3) The volume densities of forces and momenta are expressed only through the current density field. The total forces and momenta require calculation of density only on the surface of the wire. The electric balance method makes it possible to obtain closed formulas for the forces and momenta. Figures 2; references 7 (Russian).

A Method for Processing the Measurement Data for Automated Drawing of Single-Core Optical Fibers

937K0171A Moscow IZMERITELNAYA TEKHNIKA in Russian No 3, Mar 93 pp 22-24

[Article by Yu. G. Burov, V. N. Ilin; UDC 531.71:681.7.068.4]

[Abstract] With automated control of drawing single-core optical fibers, the diameter of the fiber is the principal parameter that must be controlled. An information and measurement device for obtaining data on the manufactured products has been developed. This device employs a method where the diameter of the fiber is determined by finding the phase of the period of interference rings, produced with interaction of the laser beams, diffracted on a rotating radial raster, and the single core fibers, localized in the focal plane. The interference bands are registered by a pair of photosensors, separated in space by the interval between the interference rings which corresponds to the nominal diameter of the optical fiber. A system for automatic drawing of single-core fibers has been constructed using this method and its functioning is described. A block diagram of the system is provided. Figures 2, references 4 Russian.

The Analysis of Angular Basing Error With Control of Polyhedral Optical Fibers

937K0171B Moscow IZMERITELNAYA TEKHNIKA in Russian No 3, Mar 93 pp 25-26

[Article by V. K. Aleksandrov; UDC 531.71:681.7.068]

[Abstract] A shading method and a method of measuring the forward scattering pattern are most frequently used for measuring the outer diameters of optical fibers in industrial apparatuses for their drawing. A possible transverse shifting of the fibers during the drawing process cause errors in basing, which can be compensated. Errors of angular basing caused by rotation of a circular cross section of the fiber on the measuring stand do not affect the measurement results. However, if the shape of the cross section is polyhedral, these errors become significant when controlling the distances between the opposite facets of polyhedral fiber with an even number of facets, or the height of the cross section with an odd number of facets. An analysis is made of the polyhedral fibers angular basing sources of errors, and the value of the basing error due to a systematic or random rotation of the cross section of a hexahedral fiber is estimated. Basing errors of three-faceted and four-faceted fibers are also discussed. Figures 2, table 1, references 6: 5 Russian, 1 Western.

Determining the Parameters of Frequency Instability From Distress Signalling Radio Buoys ARB-KOSPAS

937K0171C Moscow IZMERITELNAYA TEKHNIKA in Russian No 3, Mar 93 pp 27-29

[Article by I. A. Yermolenko, K. P. Pavlov; UDC 621.396.61:621.317.76]

[Abstract] A method for measuring the doppler frequency shift of signals received by low-orbit satellites from automatic distress signalling radio buoys (AERB) activated at crash sites is used to determine the site coordinates. Rigid requirements are specified for the frequency stability of the AERB signals. Deviation of the actual average frequency value from nominal can not be grater than +/-2 kH. The method recommended in the specification for determining the frequency parameters is based on measuring the frequency at three measurement intervals: the first interval is located in the non-modulated section of the AERB pulse, and the other two are located in the modulated section of the pulse. Specific errors are generated due to phase modulation when the frequency is measured in the modulated section of the AERB pulses. An automatic measuring complex (AMC) was proposed, where all frequency parameters of the signal are determined from a number of sequential frequency measurements in the non-modulated section of pulses. In addition to frequency parameters, measurements of the pulse time parameters and power at the AERB transmitter output can be made with this AMC. Values of the phase "jumps" with phase modulation in the modulated section, demodulation and decoding of information can also be made by processing the results of many frequency measurements in the modulated section of the AERB pulses using a special algorithm. Figures 2, references 9: 7 Russian, 2 Western.

Association of Power Electronics Engineers

937K0153A Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 93 pp 2-3

[Article by K. V. Kleymenov]

[Abstract] On the initiative of many specialists of the electrotechnical and electronic industry, an Association of power electronics engineers was founded in march 1992. This Association is a voluntary self-governing public group of engineers, whose creative interests lie in the area of power electronics and related fields. The Association's objective is to develop favorable conditions for professional activity of the Association members, and to enhance their input into development of power electronics. The Association's activity includes: providing information to the members, businesses and business people; conducting scientific conferences, seminars, exhibits, etc; performing scientific and engineering consultations for companies and businesses, developing various recommendations, projects, programs, etc; offering assistance in training of specialists to enhance their qualifications; establishing scientific contacts between the Association members and foreign companies and specialists. The Association pays a particular attention to preservation and development of contacts between the specialists of former Soviet republics. The Association's goal is not to expand its membership to a maximum possible number of engineers, but never-the-less avoid becoming a club for selected specialists.

Sets of Modular Systems of Digital Servo Drives

937K0153B Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 93 pp 68

[Advertisement]

[Abstract] Special Design Office "SPRUT" is advertising digital systems of servo drives. In addition to a high reliability and no need for engineering servicing, the electrical

drive is capable to automatically perform optimal adjustment of static and dynamic parameters taking into account the characteristics of the controlled equipment. The advantages of the system of digital servo drives are as follow: due to a high reliability the system can be utilized to a maximum; it has powerful diagnostics, and the modules can be replaced without tuning; it exhibits excellent servo characteristics and can be automatically computer tuned when putting into operation; the installation and replacement using modules and standard coupling elements is simple. The Special Design Office "SPRUT" also offers: Powerful transistorized modules, programmable micro PLC controller, sensors of angular and linear displacements, etc.

New Directions in Metrological Research of Mechanical Measurements

937K0125A Moscow IZMERITELNAYA TEKHNIKA in Russian No 1, Jan 93 pp 29-32

[Article by Ye. P. Krivtsov, A. Ye. Sinelnikov and A. A. Yankovskiy]

[Abstract] Efforts on measuring a number of very small parameters in accelerometry, seismometry, gravimetry and in measuring very small angular displacements, forces and pressures have become quite topical in recent years. Macroscopic oscillators, most often mechanical solid-state, are currently used for these problems. Methods and means for direct reproduction of very small forces or accelerations are required for direct determination of the metrological characteristics of the oscillators and for selecting the optimal types. Such an effort has been underway at the VNIIM [Scientific Research Institute of Metrology] imeni D. I. Mendeleyev NPO [Scientific Production Association]. A test unit was built in 1990-1991. It was used to study a group of oscillators used to record and predict earthquakes, determine the parameters of remote nuclear explosions et al. The main results were obtained in a study of PDGS-18 diffusion seismic converters, which are essentially broadband linear accelerometers, developed by the Elektron NPK (Sevastopol) especially for this test unit. Mechanical compensation type accelerometers were also studied. The two dominant sources of error found in the experiments in transmitting the dimension of the unit of acceleration were seismic noise and test unit foundation oscillation at the frequency of the acceleration being reproduced. This test unit confirmed the capability of developing a homogeneous, plane gravitational field by using test masses and using it for transmitting the dimension of the unit of acceleration in the range of frequencies from 0.01 to 0.3 Hz and the range of amplitudes from 5×10^{-9} to 1.3×10^{-7} m/s^2. Figures 4; references 5: 2 Russian, 3 Western.

Signal to Noise Ratio in Laser Doppler Velocity Meter With Single-Particle Mode of Operation

937K0125B Moscow IZMERITELNAYA TEKHNIKA in Russian No 1, Jan 93 pp 32-34

[Article by V. A. Fil; UDC 621.383.292:621.391.822.001]

[Abstract] The main problem arising in processing the signal being received by the photodetector of a laser Doppler velocity meter (LDIS) is the measurement of the signal-to-noise ratio [SNR] as a parameter determining signal quality and thus velocity measurement precision. Formulas were developed to determine signal and noise energy in a laser Doppler velocity meter at the output of the photocathode photoelectronic multiplier (FEU) and at the output of the LDIS electronic apparatus input filter. Other formulas were developed for the integral and the instantaneous SNR at the FEU output and at the output of the input filter, and for the threshold SNR at the output of the input filter corresponding to the threshold for operation of the pulse burst shaper. These formulas allow estimating the SNR given the LDIS parameters or selecting LDIS parameters given the SNR. Figures 2; references 2: 2 Russian.

Research in Real Time in Mechanics, Radio Electronics and Medicine

937K0125C Moscow IZMERITELNAYA TEKHNIKA in Russian No 1, Jan 93 pp 52-54

[Article by M. I. Gryaznov, V. I. Tverskiy, A. G. Milekhin and I. P. Krasnoshchekov; UDC 001.8:681.3.014]

[Abstract] This is a review of instruments and research methods developed at the Nizhegorod Kvarts Scientific Research Instrument Making Institute. The S9-8 and S9-16 digital oscillographs have a sampling rate of 20 MHz. The S9-27 has a rate of 100 MHz. This allows using them for the majority of measurements in the time domain. The latest domestic digital signal analyzers are the SK4-91, the SK4-92, the SK4-93 and the SK4-94. This complex allows measuring the time, spectral, correlation and statistical characteristics of signals in the range of frequencies from 0.004 Hz to 200 KHz (in the mode without missing information in time, up to 80 KHz) and to perform band analysis in the range of frequencies from 2 MHz with scan bands from 12 Hz to 12 KHz. The development of new methods of diagnostics in medicine based on analysis of the spectrum of micro-vibrations of patient extremities allows recognizing the initial stages of a number of illnesses, especially illnesses of the bearing-motor apparatus. The S4-80 analyzer has two dispersion Fourier processors with operating bands for analysis of 25 and 5 MHz and a common display. Using dispersion delay lines (DLZ), it allows measuring spectra of broadband VCh [radio frequency] and SVCh [microwave] signals in real time. Processor resolution is not less than 150 and 40 KHz, respectively; dynamic range is not less than 40 dB. Figures 4; references 11: 11 Russian.

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